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ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries

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THE occasion of the award of the *Engineering and Mining Journal* Gold Medal for the World Record in Shaft Sinking was celebrated at a banquet and general conference of the members of the *Journal* staff and of its contributors, among whom are many distinguished representatives of the mining industry, at the Harvard Club, in New York, on the evening of January 6, 1922. Mr. W. Y. Westervelt, chairman of the Board of Judges, in behalf of the *Journal* presented the Medal to the Walter Fitch, Jr., Co., replicas in silver being awarded to each of the forty-three members of the shaft-sinking crew. Mr. Fitch was represented by Mr. P. M. White. The members of the crew will be personally presented with the silver replicas of the gold medal on January 19 by the Western Editor of the *Journal*.

The New Stack at the Midvale Smelter
By D. W. Jessup

The Sierra Madre
By H. H. Taft

Flotation Tests on Zinc Table Slime
By M. H. Thornberry

Oatman Today
By W. F. Boericke

Biography of F. L. Hess

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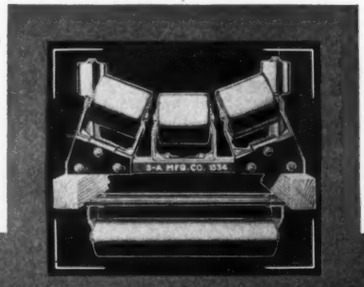

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
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The Time To Buy

THERE IS A TIME TO BUY and a time to sell. Now is the time for American companies to invest in mining properties in foreign countries. Owing to the depreciated currency of Europe, and the consequent varying but great premium on the dollar, your dollar capital is comparatively worth more than ever before, or than it is ever likely to be again. Therefore, mining properties in foreign countries can be bought on extraordinarily favorable terms, on account of the lack of competition. The general depression in the mining industries of the world is another factor favorable to the long-sighted buyer. It is average human nature to sell—mines or stocks—when prices are low and business is poor; and to buy when prices are high and business is good. In the long run—for the long pull, as the investment specialists say—there is nothing of more solid value than a good mine of any necessary metal. It is sure to recover its value, and in the case of many metals at least, it will gradually acquire a higher value, as the mining of metals renders more valuable what has not yet been mined. The time to invest is now.

A certain amount of American capital has actually gone recently into European mines. Mexican mines have been acquired during the past few years by active companies. But it is safe to say that the evident opportunities will in general be passed by. The mining companies are not prosperous—are not operating, or are operating at a loss. The renewal of the demand for metallic products has been slow in coming; and the tendency will naturally be all against further extensions under the circumstances. It will be in later years, when business is booming and there is surplus cash in the treasuries, that new properties will be sought in foreign countries; only at that time the price must be paid down accordingly.

Consulting Practice and Mining Education

THERE IS A STEADY ACCESSION to the consulting field coming from operating positions and various ramifications of the mining industries. Apparently it is the mecca toward which engineers trend in more or less uncertain fashion. We wonder how much is really known about it as a business. Certainly there must be a considerable number in it, but we have no adequate measure of the success of its participants nor of the methods taken to insure success and provide enough continuity in the line of clients to keep the coin jars on the home hearths jingling. How much of a feast or a famine is it? At the moment we do not know of any seasoned consultant who has candidly spread his experiences before our technical societies. We have seen an occasional paper on engineering ethics, but not for a long time past. We do not know whether some of our mining schools have given any serious attention to the business of the consultant or not? How many of them analyze the structure of this business. Do they instruct their students how to get and to hold clients? Is there an adequate effort made to give a student an insight into the subtle art of selling his services? Do they take up such subjects as fees, ethics and the pitfalls that beset the neophyte? Do they warn him of dead ends and the importance of safeguarding his professional and private reputation? It's a safe bet that they don't, or, if they do, it is only a casual reference. Between the interval of graduation and the consulting field a relatively long time may supervene, and therefore some will reason that there is no pressing need for such instruction. Others will represent that experience will supply all that is needed. Perhaps it will, but then again it may not. Certainly it would be helpful to have a well balanced analysis of this future business in the hands of the graduates as a rack upon which to hang his individual experience.

The American Valuation Plan

IN THE MIDST of the confusion welter of assertion and denial from those whose interests are affected by the proposed American Valuation Plan, many are turning to the professional economists for counsel. This group takes a remarkably united and unequivocal stand in opposition to the measure. The grounds upon which they take their stand are roughly these:

In the first place, they believe that the proposed plan really means a higher tariff. They recognize that the precise rates to be imposed on the American values are the determining factor here, but they are convinced that those urging the plan intend to see to it that the rates shall be sufficiently high to cover any uncertainty incident to the establishment of the new valuation basis. They suspect that at bottom the proposal resolves itself into a demand for a hidden and undetermined amount of increased protection.

The arguments, aside from this, do not impress the economists. The three which contain some modicum of force are that the plan will meet the problem of the fluctuating exchanges, that it will prevent "dumping" and that it will put up a more effective bar against the country with exceptionally low production costs. The economists point out, however, that prices rise in countries whose exchanges fall and that any disparity in the two movements is largely offset by the internal disorganization of the productive forces in the country whose exchanges are violently deranged. "Dumping," they believe, can best be prevented by administrative measures applied when the facts of a particular situation demand them. The argument that the present method of valuation puts a lower duty, for example, on cheaply produced Japanese goods than on more expensively produced European goods of the same character is admitted, but it is pointed out in rebuttal that specific rates would meet this situation as well as the American valuation plan.

On the other hand, the economists are considerably influenced by the contention that the adoption of the proposed plan would introduce so much uncertainty into the process of importing goods as to greatly embarrass the process. A retailer, buying foreign merchandise, cannot estimate his costs with any degree of precision under the proposed plan. Uncertainty of this character is a very potent anaesthetic to business enterprise. The economist suspects that the adherents realize this and view it with complacence because it means fewer imports and less foreign competition.

The administrative difficulties of securing fair cost figures from American manufacturers interested in excluding their rival's goods, of determining American costs in the case of goods which America does not make, and of securing uniform valuations at various points of entry, are perfectly self-evident. Furthermore, it is contrary to all past practice and procedure in this country. It constitutes, in the words of Professor Taussig, the foremost student of the tariff in this country, "a veritable leap into the dark."

But, after all, the opposition of the economist rests back upon his conviction that the proposal is equivalent to a demand for increased rates at a time when the true economic interests of the country would not be served by the establishment of a high tariff wall. The changed conditions resulting from the war have convinced many who previously were in favor of high protection that we cannot hope for a real business recovery until we reach an economic adjustment which the high tariff will tend to prevent or postpone. The question of American Valuations should not be settled without a full consideration of all of these elements.

Mining Schools in a Mining Environment

WE HAVE BEEN ASKED whether it is necessary, for the success of a mining school—and by that we mean, of course, the success of its graduates—that the mining school be contiguous to or a part of a mining environment. The Committee on Technical Education of the Mining and Metallurgical Society of America has this to say on the subject:

"If other things are equal, the mining school situated in a mining environment will obviously have an advantage over that not so situated. To overcome this advantage the schools remote from mines must possess some compensating advantages. It is urged by many, of course, that the mining schools connected with the great universities more than offset their handicap of location by their general strength of resources, whether in material or in staff, by the broadening influence they exert, and by the power of their traditions and prestige. The one advantage is tangible and inherent, the other is complex and acquired; balancing of the two is difficult, and this committee prefers not to enter on any such uncertain or dangerous ground."

We agree with the committee's conclusion in the principle that it is extremely difficult to weigh the relative advantages and disadvantages of the two alternatives. There is something to be said on both sides, as the committee infers. Freiberg, once famous as a great mining school, was in the heart of a mining district. The Michigan College of Mines, in the copper country, has a splendid record in its graduates. Nevertheless, Columbia, the Massachusetts Institute of Technology, and others also have excellent records. Western mining schools have been an important factor in supplying graduates to the mining industries. Thus the degree of the essentiality of the mining environment cannot be determined from the record of the schools.

Contact with a going mining district gives a student a sense of proportion and wears off a certain greenness that is inevitably present if a student has had little or no contact with mining. Trips to mining districts and the common requirements that mining students must spend a stated time in employment or in studying actual mining operations compensate to some extent for the lack of a mining environment. Modern facilities for travel, the railroad and the automobile, contribute in bringing mining districts nearer to distant centers. Too long a time in one mining district probably gives a student an exaggerated idea of the importance of the practice in that district, and this must be avoided by excursions to other districts where conditions are different. Thus the school in a mining environment must face a similar problem differing only in degree from that of the school at a large population center.

Most important are the ideals of the school and the personnel of its faculty. If these are excellent, the mining environment is an added advantage. If they are indifferent, the school that possesses excellent ideals and personnel has, in our opinion, a greater value to the student, even though it has no mining environment.

It is more important that the mining students' fundamental work be thorough, and this requires good teachers and standards. Sometimes these pertain in the smaller schools, but just as frequently they do not. They are more often found in the large and well-established schools. Another angle to this question is the fact that the mining-camp environment does not always attract the highest type of instructor, for the reason that there is little intellectual stimulus in a mining district and the social conditions may not be always attractive. Again, the educational opportunities for the instructor's family (and he sometimes has a family) may not be satisfactory. There is a well-marked tendency, we believe, for the best instructors to gravitate to the larger schools in a diversified environment, for here the intellectual opportunities and social advantages are greater.

For some years there has been considerable discussion of the need for greater cultural development for the engineer. To specialize this into definite courses to be prescribed to a prospective engineer and "intruded" or superimposed upon his technical education is extremely difficult. Nevertheless, a diversified environment and contact with other students and instructors in other lines of work is conducive to a certain stimulus in this direction. Tradition and prestige in the larger schools are additional factors.

We consider the plan of having the first two years of instruction given at a well-established university and the remaining two years at a mining school in a mining community as worthy of discussion. This arrangement would avoid some duplication and would provide suitable environments for the respective faculties.

Humanizing Geology

THAT GEOLOGISTS CAN BE PRACTICAL and efficient in managing a convention has been happily demonstrated by the geological department at Amherst College, in co-operation with the various geological societies which met at that college by invitation during the Christmas holidays. Professor Loomis, of Amherst, and his assistants left no stone unturned toward making visitors comfortable and anticipating their characteristic touristic troubles. It was a demonstration

of the humanizing process which has gone on in geology. This process has been evidenced, also, in recent years by the linking up of geologic science to the uses of humanity. Thus have arisen mining geology or geological engineering, hydro-geology, petroleum geology or engineering, civil engineering geology, military geology, political and commercial geology, and other definite branches. The Society of Economic Geologists, in which the various branches of applied geology naturally head, showed great strength in this meeting, and noteworthy papers and discussions ranged all the way from ore genesis to ore reserves and production. The promising future of the society was further assured by the election for president, from a triangular ticket, of Mr. Waldemar Lindgren, experienced field geologist, leader in geologic thought, and author of the most advanced textbook on ore deposits; and, also from a triangular ticket, of Mr. Ralph Arnold as vice-president, thus assuring the important group of petroleum geologists an adequate representation.

For the Geological Society of America, which, with its affiliated societies, also met at Amherst, the occasion was outstanding for the honors paid to the venerable geologist, Emerson. He and his predecessor, Hitchcock, have together held the chair of geology at Amherst for an even hundred years. The address of the retiring president of the Geological Society of America, Prof. James F. Kemp, was on the subject of ore deposits, and was a most noteworthy review.

WHAT OTHERS THINK

The Future of Mining

In *Engineering and Mining Journal* of Dec. 10, 1921, appeared a first-column editorial, the caption of which is "The Future of Mining." The obvious purpose of the editorial was to set forth the importance of American participation in foreign mining developments. In the prefatory paragraphs appear the following statements:

"Meantime, great organizations of capital, served by exploration, geological, and engineering talent, have been systematically sifting the country for new mines of low or high grade wherein to invest the funds they have reaped from the mines they have exhausted or are exhausting. Thousands of mines and prospects are examined, and perhaps one in a thousand or one in five thousand, if the investigators are patient enough, can be made to yield some profit.

"It is the gleaners—so soon—going over the field. And there have been many of them, for there are many strong companies whose exploration departments have followed one another from preferred mine to possible prospect. Some of our great companies have quit—abandoned their exploration departments and contented themselves with what they have, giving up the idea of replacement, and perhaps embarking their surplus capital on other lines of business."

These statements have been construed by some of your readers as a virtual "obituary" on American mining. Perhaps this implication is not fair to the writer of the editorial, but as the issue has been thus raised, it seems to me that it would be in order for the *Journal* and its editors to undertake a survey of American mining, so as to advise the readers of the publication and the large public interested in American mining, either financially or vocationally, as to the near future of the industry and the possibility of its effectual extinction during our time. It is admitted that the American mining industry is at the present time greatly curtailed in every way, but as this same thing might be said of other basic industries, the admission does not infer permanent and complete decline. It must be admitted that the American mining industry has reached that uncertain status known as "middle age," but this does not necessarily imply that a tombstone is immediately needed.

It may be accepted that American mining is sick, and it would certainly be interesting, and it might help the industry to more healthy activity and to longevity, if the *Journal* could add to its own editorial discussion, as to the future of American mining, the opinion of some of the veterans in the business, many of whom now have some time in which to record their ideas.

By way of starting a discussion, I submit the following extracts from a leading editorial in the *Journal* of May 25, 1912, entitled "Some Reasons Why Mining Languishes." This editorial, discussing the report of the exploration department of the U. S. Smelting, Refining & Mining Co., wherein it is set forth that the company had, during 1910, considered 684 separate mining propositions, of which 268 were examined, with the result of acquiring finally only *three* mines, says:

"It is not to be inferred from these figures that out of the mining property in the market 99 per cent is valueless; rather do the figures point to the inability of buyers and sellers to come to terms."

In discussion the editorial continues:

"Experience teaches that the common idea among mine owners is to demand all that a mine has actually developed, plus all probability, computed as to net value on the basis of what the large company can accomplish by virtue of its superior organization, knowledge, and command of capital. The standing upon such a demand is, of course, obstructive, because there is no use for a buyer to acquire a mine if he has to take all the chances and can only get his money back if all hopes are realized. The view of the purchaser is to pay for the ore developed plus a reasonable allowance for probability, figuring net value on the basis of what the owner can accomplish in his own working.

"A reason why more mines are not taken over and exploited energetically by modern methods is the failure to reconcile the widely varying views of buyer and seller. Obviously the position of the average seller, as indicated in the foregoing paragraph, is quite unreasonable, and undoubtedly stands in the way of progress in mining. Here enters the question to which we have repeatedly referred, viz., Would it not be wise for the states wherein mining is becoming decadent to adjust their system of taxation so as to promote it? The conditions under which much mining property is held at present are not greatly different from those of much suburban real estate that is held out of use, by virtue of an unduly lenient system of taxation, awaiting a realization of unearned increment."

This earlier-day diagnosis of the mining situation is interesting, and the proposed remedy is ingenious and one not altogether acceptable to the "covetous" owners of mines, I am sure. At the present time, however, due to the general financial disturbances of the past seven years, it is a well-known fact that mine owners are generally disposed to offer their properties for sale, or financing, at much lower prices than have prevailed previously, and also usually on very attractive terms. The remedy for present conditions must therefore be

worked out on some other formula than that set forth in the *Journal's* editorial of 1912.

I do not think that American mining, as a whole, has yet approached the period of general decline, and certainly not the state of total obliteration. It has inherent vitality to come back under the stimulus of general resumption of normalcy in the world's business, and there are new conditions affecting the cost of producing the metals and the market for them which will prolong American mining as one of the great basic industries for many years. KIRBY THOMAS.

New York.

The Eubœan Magnesite Field

In *Engineering and Mining Journal* of Dec. 3, C. S. Maltby takes me to task for having stated in my article on "The Eubœan Magnesite Field" that "Greece . . . produces the world's purest magnesite." In using those terms I had no intention of either unduly eulogizing the Grecian product or depreciating that from California, but rather was guided by such reports and figures as were available with regard to California magnesite, the experience of those in America who have handled both that and the Grecian article, and also by Greek records covering the export of magnesite for the last forty-five years. F. B. Romey, in the *Mining & Scientific Press* for April 19, 1919, contributes an article on "Hewet Magnesite" (from Riverside County, Cal.), in which he gave an analysis of calcined magnesite from that mine containing 14.46 per cent of silica, meaning 7 per cent approximately in the crude mineral, a much higher percentage than that in Eubœan magnesite.

While in Greece recently I supervised the shipment of 4,000 tons of crude mineral from Eubœa. This had to be transferred from the stockpile in one-ton cars, and a "grab" sample was taken from each car. The shipment consisted of two lots, of 2,500 and 1,500 tons. The bulk sample from each lot was reduced, and both were submitted for analyses to P. A.. Zalacostos, the director of the chemical laboratory, Ministry of National Economy, Athens, Greece.

The results of the analyses were the following:

	Lot of 2,500 Tons, Per Cent	Lot of 1,500 Tons Per Cent
Silica	0.86	1.54
Oxides of iron and alumina	0.55	0.33
Lime	0.55	1.21
Magnesia	46.94	46.38
Loss on calcination	51.10	49.84
Moisture	Nil	Nil
Total	100.00	100.00
	Per Cent	Per Cent
Equivalent to magnesium carbonate	98.57	97.39

These figures indicate a high degree of purity in a crude mineral, and samples taken from picked pieces would have given even better results. With regard to Mr. Maltby's implied unsatisfactory experience of the quality of Grecian magnesite, I think that this must have been due to lack of proper precaution. When Grecian magnesite is purchased in a businesslike way, and from reputable firms, a magnesium carbonate content of 94 per cent is guaranteed, and the payment of a considerable portion of the purchase price is made contingent on agreement of the analysis made from a bulk sample properly taken at a United States seaport, with the guaranteed percentage.

Mr. Maltby refers to the necessity of "cobbing" or dressing the Grecian magnesite, and infers that this is not necessary with the California article. In the *Mining & Scientific Press* for Aug. 30, 1919, W. C. Phalen had an article entitled "The Magnesite Industry in the United States." *Inter alia* he wrote of the California deposits: ". . . Some of the magnesite masses are as much as 30 ft. in thickness, and from this thickness they range to mere stingers and gash veins too thin to work." The maximum width of the California deposits thus appears to be 30 ft. The maximum in Eubœa (as I stated in my article) is 130 ft.

Most of the Grecian magnesite requires no preparation for sale, but a portion of otherwise too impure mineral can be rendered workable by a simple cleaning from adhering serpentine. If the demand for magnesite ever justifies it, a simple process of mechanical dressing would render a large part of the deposits now discarded as waste fit for sale.

In the interests of accuracy and scientific truth, will Mr. Maltby please give figures comparable to the foregoing to confirm his at present unsupported positiveness with regard to the superiority of California magnesite? Until he does so I shall continue to believe that "Greece provides from the Island of Eubœa the world's purest magnesite." HARRY C. BOYDELL.

University of Wisconsin.

The Proposed New Mining Law

It is evident, to most of us in the West, that H.R. 7736 has not the ghost of a chance to pass. Whether on not its demerits justify this, is immaterial; an overwhelming majority of the men engaged in the mining industry, in the states affected, are opposed to it.

As (I hope) practical people, the question now arises, —what shall we do about it?—shall we let the matter drop, for the next generation to consider?

Nearly all agree that the principal advantage to be hoped for, under the proposed law, is that it might facilitate the discovery and development of new districts; especially where there is reason to suspect the existence of ore deposits which do not outcrop. It seems generally admitted that there is little to be gained from its adoption in old districts, where most of the important orebodies have already been discovered, and located under the present law. On the other hand, the opposition comes, naturally, from such districts. Why not therefore solve the difficulty in a common-sense way, by making the new law apply only to new districts; or perhaps only to districts, to be indicated by the Geological Survey, where there is ground to surmise the existence of buried deposits? This solution was advocated by the writer in 1907, and met with the approval of high legal authorities.

In any event, certain features of the proposed law such as the limitation of time during which locations can be held without patenting, permissive payment in lieu of assessment work, and the requirement that locations shall conform to section lines, will have to be abandoned. These features were contrary to the judgment of most Western engineers, and are extremely unpopular with prospectors. The extralateral right in existing districts will have to be left as it is, unless the collective judgment of a community, as at Leadville or Bisbee, should agree tacitly to ignore it.

Denver, Colo. GEORGE E. COLLINS.

[Note: The revised mining law as proposed in H.R. 7736 does not affect claims already located. No such law can be made retroactive; therefore claims located before the passage of any new law will always retain extralateral rights, as under the old law. EDITOR.]

The New Stack at the Midvale Smelter

Weight of Over 8,000 Tons Necessitated Careful Planning for Foundations —Construction of Highest Quality and Completed in Six Months From First Excavation — Gases Will Be Liberated at a Height of 451 Feet

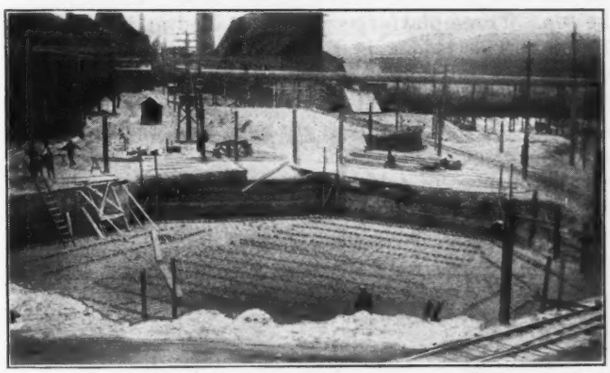
By D. W. Jessup
Written for *Engineering and Mining Journal*

THE 451-FT. STACK just completed at the Midvale, Utah, plant of the United States Smelting, Refining & Mining Co. was placed in operation on Nov. 26, 1921. Though it was practically finished during the latter part of October, time was needed to remove the scaffolding, make necessary repairs in the baghouse, and finish the flue connections.

Under the direction of L. D. Anderson, chief engineer, the construction of the stack was contracted for by the Wiederholdt Construction Co., of St. Louis, with J. D. Martin in charge. The foundation was sublet to Villadson Bros., of Salt Lake City. Not only was the best of material and labor employed, but a record was made in the speed with which the structure was built. Never has a stack of this size been erected in so short a time. This was because of an efficient organization and propitious weather conditions.

The exact height of the stack is 451 ft. 4 in. The outside diameter at the base is 46 ft. 1 in. and the inside diameter is 39 ft. 5 in. At the top, the outside diameter is 29 ft. and the inside, 24 ft.

Excavation for the foundation was started on April 29 and was finished in about three weeks, several days being required to test the ground for subsidence. Laying of the foundation was begun on May 26 and finished June 15. Two weeks were allowed for the cement to set. The first work on the stack proper was on June 30, and by Oct. 20 the chimney was finished. Two



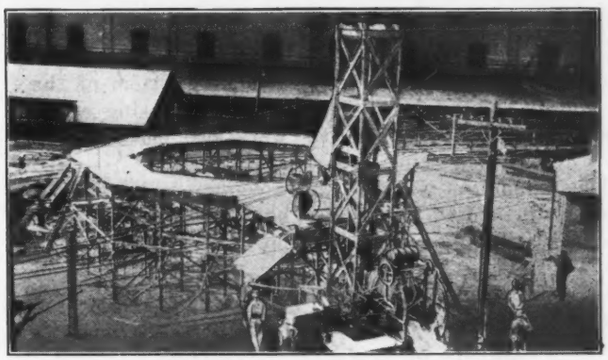
LAYING THE REINFORCING RODS FOR THE CONCRETE FOUNDATION

weeks were necessary to tear down the inside scaffolding, piece by piece, and leave the structure ready to handle the smelter gases.

In the meantime, many alterations and changing of the flue connections were made. The baghouse roof was repaired and the large flue connecting the stack to the baghouse was built. Since starting up, absolutely no operating troubles have arisen.

The preliminary survey consisted of boring seventeen holes with a well digger to determine a foundation site. The holes varied from 30 to 5 ft. in depth, with a casing 3 in. in diameter. The lower 6 ft. of the casing was a split pipe held together by a ring at the top and bottom. When the pipe reached a depth of 6 ft. it was withdrawn and opened and the core removed and placed in a box. This was done for each 6 ft. of the hole. In this way a complete core was obtained. The soil was found to be fairly uniform, with a sandy top underlain by alternating layers of clay and sand.

An 8-ft. layer of water-bearing sand, almost like quicksand, was found at a depth from 24 to 32 ft. It contained 25 per cent of moisture. Underneath this sand was a predominating bed of impervious blue clay, which was followed by a micaceous clay that bore evidences of being eroded from the Little Cottonwood



THE CIRCULAR TRACK FROM WHICH THE CONCRETE FOUNDATION WAS POURED

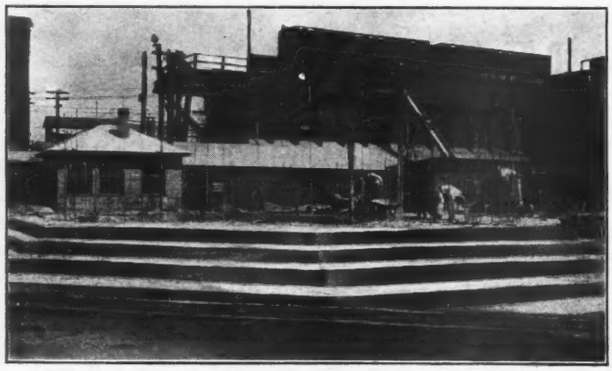
granites. A gravel bed underlaid the clays, and as it proved too troublesome to keep the hole open, drilling was discontinued at about 63 ft. Cores of each hole were kept in boxes, to obtain complete data of the underground structure.

The Salt Lake Valley is the bed of the prehistoric lake Bonneville, which disappeared about 30,000 years ago, leaving the present body of water, the Great Salt Lake. Streams from the near-by Wasatch Mountains fed this lake, and these bore-holes made an interesting geological study.

Foundation Was Tested Before Building Began

It was decided to erect the stack a short distance south of the baghouse, having in view other flue connections that might be made in the future. Owing to the densely packed nature of the soil, the excavation for the foundation was made only 10 ft. in depth. The soil was removed with scrapers and teams, and the finishing touches were done by hand labor. A testing machine built of 6 x 6-in. timbers, and carrying a load 50 per cent greater than the weight of the stack, was then placed in the center of the excavation. At the end of seven days the ground had settled only ¼ in.

Preparatory to laying the concrete foundation, a circular wooden platform or track was constructed inside the excavation; this was about 20 feet high and was carried on 4 x 4-in. supports. Chutes for dumping the concrete were built on both the inner and outer edges.



THE FINISHED FOUNDATION—NOTE UPRIGHT REINFORCING RODS

Sand and gravel were trammed from near-by trestle bins by specially constructed wheelbarrows or buggies and dumped into a concrete mixer; portland cement and sufficient water were added and the whole was mixed for one minute. The mixture was then hoisted in an elevator bucket and dumped into a pocket, from which it was drawn out and trammed by buggies around the circular platform, being distributed where needed. Before pouring the concrete, reinforcing rods of 1-in. square deformed shape were laid on the bottom of the excavation, spaced 1 ft. apart and crisscrossing at an angle of 45 deg. These rods were also placed in an upright position, being held by wire.

The foundation was laid in an octagon shape, 87 ft. in diameter and 10 ft. thick. The lower 5 ft. is a solid block and the upper 5 ft. is stepped in at each foot so that the top is 51 ft. across. Later, the top was covered with soil. Upright reinforcing rods were left standing to anchor the base of the stack.

Method of Building Scaffolding

After the cement had set, the inner scaffolding for the stack was started. This consisted of a double compartment tower, 14 ft. square and built of eight 6 x 6-in. posts in twenty-nine full 16-ft. sections. It was held together by 2 x 12-in. ledgers and 2 x 8-in. sway braces, securely bolted. The tower was kept three or four sections ahead of the wall.

A movable table or platform constructed of steel members was built around the tower. It was supported underneath by angle braces. The table was held in place and also raised through the medium of eight two-ton chain blocks. When the wall had reached a certain height, the table was hoisted a few feet and the bricklaying again started. The blocks were moved to a new position when necessary. Careful inspection kept the wall in line, and no irregularities were allowed.

To hoist the material, two 5 x 8-ft. cages were operated inside the tower. They traveled at the rate of 400 ft. a minute. The hoist was of the double-drum mine type, with an a.c. slip-ring motor of 75 hp., the voltage being 440. The cable was of $\frac{5}{8}$-in. steel.

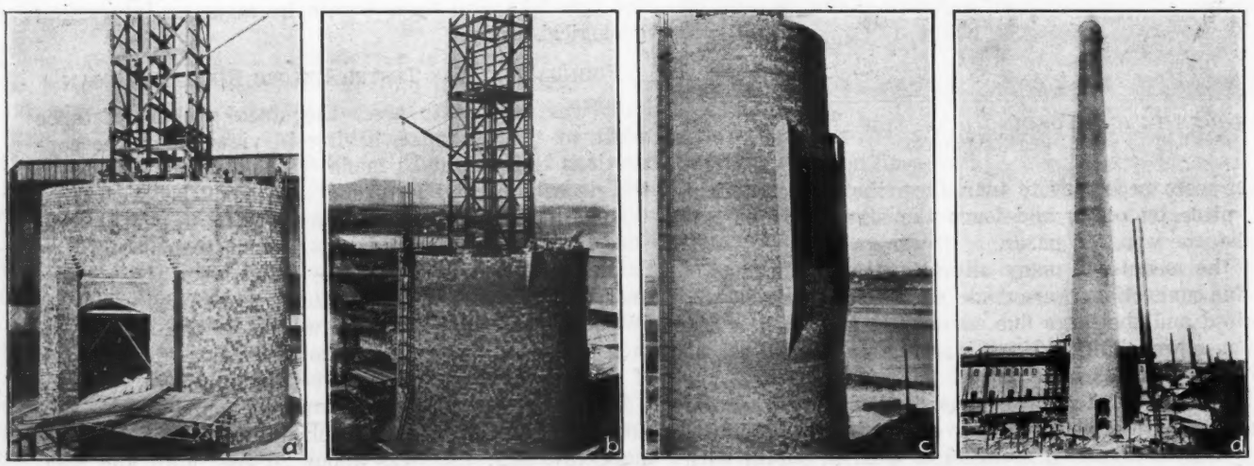
The stack consists of an inner and outer shell. The inner shell is a lining built of $4\frac{1}{2}$-in. soft-glazed hard-fired brick; primarily this is for insulation. The lining extends from top to bottom and is held in place by expansion joints. A 3-in. air space was left between the walls. The first 125 ft. of the outer shell is of hollow radial brick filled with reinforced concrete. It is 33 in. thick at the base, and at the 125-ft. mark it decreases to $17\frac{1}{2}$ in. From this point to the capping the wall is made of Wiederholdt patented brick or tile, filled with reinforced concrete. The thickness is $12\frac{1}{2}$ in. up to 190 ft., and 10 in. for the next 90 ft. This decreases to 8 in. at the top.

At intervals of 25 ft., the main wall is corbeled out to carry the lining. At these points, special tile is used to make a slip or expansion joint; this permits the lining to expand and telescope with the section above it. The joint extends all the way around. The chimney head is corbeled out and is covered with a 30-in. cast-iron cap made in sections and bolted to the top with anchor bolts. The latter are protected by cast-iron covered nuts.

To avoid danger from lightning, eight lightning rods of the Carl Bajoler type were installed. These are tipped with a very thin foil of platinum to protect the points against corrosion. Two $\frac{5}{8}$-in. copper ground-cables, one on each side, are connected to the rods and will carry any discharge 14 ft. below the surface.

The stack is provided with a safety ladder extending to the top. Three platforms were installed at intervals of 150 ft. The ladder is inclosed by horizontal and vertical straps, so that it is almost impossible for one to fall out except straight downward. It was hoisted in sections by the aid of a gin pole and tackle and bolted into place.

For the purpose of taking gas readings and samples, a pipe was extended across the stack at the 300-ft. level. The pipe is made of iron, but is covered both

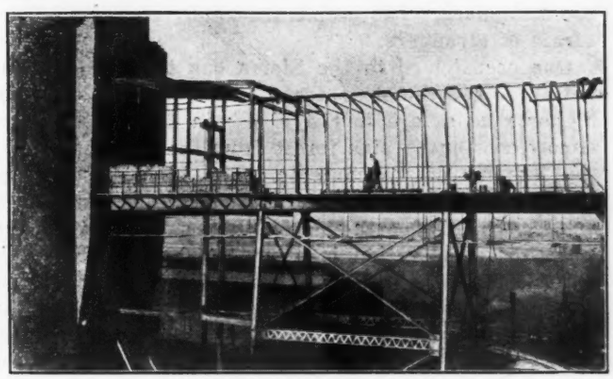


THE STACK AT VARIOUS STAGES OF CONSTRUCTION
(a) 35 ft. (b) 45 feet. (c) Flue opening at baghouse. (d) The completed stack.

inside and out with sheet lead. There is a series of ⅜-in. holes through the bottom of the pipe to permit the gases to enter. This pipe will extend to the ground and a rotary blower will suck out the gases so that the chemist will not have to climb a ladder to take his sample.

THE ARRANGEMENT OF ENTERING FLUES

At the bottom of the stack was built a flue opening or portal 12 ft. 3 in. by 22 ft. 3 in. There is a possibility of this opening being used in the future, but for the present it was bricked in. The portal leading to the baghouse was made 15 ft. 6 in. by 22 ft. 2 in. The flue connecting the stack to the baghouse is 16 by 14 ft. and 86 ft. long. It is supported by a steel tower 55 ft. 7 in. high and 28 ft. wide. The first 30 ft. of the flue is built of tile with firebrick lining, the remainder of double-wall transite filled with ground cork between the walls for insulation, and supported by a steel frame work. The roof is insulated with felt instead of cork. The transite is an acid-proof board consisting of a mixture of ground asbestos and cement, made by the Johns-Mansville Co.



FRAMEWORK OF FLUE CONNECTING BAGHOUSE TO STACK

At present a firebox with a coal stoker feed is being installed at the base of the chimney, so that during certain seasons of the year heat may be applied to the smelter gases, causing them to rise to a greater height and be diffused more completely in the atmosphere.

All of the construction work was done on one shift daily, the crew numbering thirty-one men. This included carpenters, bricklayers, helpers, laborers, and an engineer. The largest number employed at any one time was thirty-five men. During the entire period of building, only five hours were lost, this being due to a severe rainstorm in August. Other than this, the weather remained ideal.

A "Safety First" campaign was conducted, with excellent results. Only three accidents occurred. They were not of a serious nature, and no time was lost by the men. After the stack was finished, and while tearing out the scaffolding, one employee was so unfortunate as to have his leg broken. This marred an otherwise perfect record.

The sand and gravel for concrete work was obtained from near-by pits. After a careful inspection, a chemical analysis and sizing tests were made to determine if they were suitable. The brick and tile were made locally. In mixing the concrete for the stack building, one part of cement was added to three parts of sand, with sufficient water to make a dry mix.

The weight of the whole structure is enormous. In the stack there are 15 carloads of cement and in the foundation 12 carloads, a total of 1,962,000 lb. The stack contains 33 cars of sand, and the foundation 21 cars, or 5,698,000 lb. The foundation contains 40 carloads of gravel, weighing 4,590,000 lb. (the stack contains no gravel). The brick and tile used in the stack weigh 4,353,000 lb. and make up 65 carloads. Two carloads of Utah Copper tailing were used in the mortar for the brick lining with the idea of making the mortar more acid proof and also of a thinner consistency. The bar iron for reinforcing the concrete weighs 50 tons, and a large amount of water is contained in the concrete, mechanically and chemically combined. The weight of the total material is 16,903,000 lb., or 8,452 tons. This amounted to 188 carloads. With all of this great weight, the structure has settled only 1¾ in. and part of this is due to the shrinkage of the concrete. The settling has been entirely uniform.

The erection of the stack marks a new era in smelting at the Midvale plant, and it appears that all draft problems have now been definitely solved.

The Copper Mines of Eastern Finland

Negotiations have recently been carried on between the owners of the Outokumpu copper mines, in eastern Finland, and some German copper-mine owners for the lease of the Outokumpu mines or the sale of the raw ore from them, according to *Commerce Reports*. It is stated that enough ore is being produced at present in one month to suffice for smelting for one year, but that it is intended to double the productive capacity of the smelting works, in which case the production of two months can be utilized here and that of ten months can be disposed of otherwise.

There is considerable opposition on the part of experts in this country to disposing of these mines or their products, as they are considered to be a valuable asset for Finland.

The Outokumpu ore field is located in the district of Kuusjarvi, 50 kilometers from Joensuu and 90 kilometers from Kuopio. It consists of a long, flat layer of quartzite, which, according to borings already made, appears to be 2,500 meters long and 200 or 300 meters wide, with a depth of 9 to 10 meters, as stated above. The ore contains on an average 4 to 4.5 per cent of copper, 27 per cent of sulphur, 28 per cent of iron, and approximately 1 per cent of zinc, as well as small quantities of silver and gold. The mineralogical composition of the ore is on an average 12 per cent of copper pyrites, 32 per cent of sulphur pyrites, 15 per cent of magnetic pyrites, 1 per cent of zinc blend and 40 per cent of quartz.

Notwithstanding the importance of the deposits of copper and sulphur at Outokumpu, these mines have never been worked with much success. The ore was first discovered in 1910, and trial work began three years later. The following table shows the annual production of ore and of copper since 1914 and the value of the copper:

OUTOKUMPU PRODUCTION OF ORE AND COPPER

Year	Ore *Tons*	Copper *Tons*	Value of Copper *Marks*, a	Year	Ore *Tons*	Copper *Tons*	Value of Copper *Marks*, a
1914	7,500	148.2	375,000	1917	15,000	145.6	1,140,000
1915	9,800	157.1	580,000	1918	17,200	69.5	1,300,000
1916	12,000	175.8	1,025,000	1919	11,000	15.6	138,000

a The normal value of the Finnish mark is $0.193, but it is now greatly depreciated.

The Sierra Madre of Northwestern Mexico

A Description of the Country — Topography, Inhabitants, and History—Range Formations Essentially Volcanic and Remarkably Mineralized—Many Famous Camps—Present Conditions and Outlook

BY H. H. TAFT

Written for *Engineering and Mining Journal*

OF MOUNTAIN RANGES called Sierra Madre, "Mother of Mountains," there are many. The highest area in Mexico is about the City of Mexico. Humboldt describes three ranges spreading northerly. The middle one breaks up into small detached mountains in the central plain or basin. The others become the western and eastern Sierra Madre respectively. That to the west is the larger and more commonly bears the name. On the western side is the greatest and richest mineralized region of the North American continent.

Both of the ranges are nearly parallel to the coast, being closer to the sea on the south. North there is a constantly widening coastal plain, and in Sonora are several smaller chains. In both areas streams of water rise in or near the central plain and break through in deep canyons on their way to the sea. In Chihuahua the river at Guerrero flows north; at Yepomera it flows west and breaks into the mountain range, receives a stream from the south, breaks through another range in a canyon as the River Arros, flows north and receives the Chico, flows south and west again to receive the Mulatos, then north and west in a deep canyon all the way and receives the Bavispe, and flows west and south again as the Rio Yaqui. A deep canyon and one rich in mineral is the Urique, which is from 3,000 to 6,000 ft. deep and in picturesqueness rivals the canyon of the Colorado in the United States. An east and west profile is that of an ordinary mountain range turned over. The general country and the nearly flat lands are on top. The valleys are deep and narrow, often several thousand feet below the general level. South, about the latitude of Guadalajara, the range bends east and continues to the isthmus. In this section it is not so rugged and precipitous and there are many large tracts of grazing and agricultural land. Although it contains some good mines, it is not as well mineralized as the north.

DISTANCES MEASURED IN HOURS AND DAYS

Distances are of little account in the Sierra. One does not often hear of miles, leagues, and kilometers, but, instead, of hours and days. Ordinarily, one travels by horse, or, better, on mule-back from twenty-five to thirty miles per day. In some regions three days are required to gain fifteen miles; occasionally that distance can be made in two or three hours. There are few roads, and all freight is carried on the backs of animals. There is but one railroad across the Sierra, that from Tuxpan to Colima. Three other roads are projected and partly constructed. To the miner the most important will be the Chihuahua-Sinaloa line, known as the "Orient." The mountain range is from 100 to 200 miles wide. Railroad construction is difficult enough on top, but there are only a few places where there is room to get down on the west side with a grade that is not too steep for traffic.

The country is fairly well inhabited, and one rarely travels more than a few hours without seeing ranches and small towns. The natives will plow, cultivate and raise a crop on a 35-deg. slope. One finds all kinds of fruit, from apples to bananas, though they are not good for much, being practically wild. Occasionally one meets a more enlightened rancher who has been north and purchased some good nursery stock. The people belong to various tribes of Indians, with a little admixture of Spanish. In the south there are many who speak only the local dialect, but north nearly all understand Spanish and some English, for a surprisingly large number were, at some time or other during the last ten years, refugees in the United States. The land holders and storekeepers are *gente de raison.* Most of the towns are communes. The people are kindly enough, but are afraid of strangers.

One accustomed to the Sierra can tell the elevation within a few hundred feet by the vegetation. The higher reaches are in the pines; in fact, there is an almost continuous pine forest from the Arizona line to the Isthmus of Tehuantepec. The highest parts are between 9,000 and 10,000 ft. above sea level. At 9,500 ft. and lower on the north side one finds hemlock and cedar. The average elevation is about 7,000 ft., and at this altitude the oaks begin to show scattered through the pines. At 6,000 ft. the pines give out and through the oak one finds juniper and cedar, which become the principal trees a little lower. In the oaks and the lower pines is the picturesque red-barked madroña. There is none of the cacti and thorny growth in these uplands that one usually looks for in Mexico. The barrancas are semi-tropical. Oranges, limes, lemons, pomegranates and other fruits are found. Near Urique is a coffee grove.

FORMATIONS OF RANGE PRINCIPALLY VOLCANIC

The entire range is essentially volcanic. There is little of the black lava so often seen in the Rocky Mountains and the Cascades in the United States. This is on top, the latest formation, for it is recent. The last flow was in 1756, when Jorullo, in Michoacan, overflowed and destroyed a rich farming district. The great mass of the Sierra is made up of light-colored flat-bedded volcanic tuffs, in all from 1,000 to 2,000 ft. thick, so bedded that one in passing often thinks of them as recent sediments. Under these beds are a great variety of intrusive rocks, porphyry, diorite, andesite and others. Granite does not appear until near the coast. These rocks are nearly always mineralized.

Rarely does one drop off of the high mesa into the barrancas without going into a *mineral.* Occasionally in the valleys there is a development of the sedimentaries. In southeastern Sonora, coal occurs, the sandstones and slates so metamorphosed as to be unrecognizable from the saddle. The coal is crushed, and altered to a high ash and low volatile content. There are a few instances where the eruptives reach the higher elevations and the miner does not have to get his ore out of a deep barranca. In the Barranca del Cobre, on

the Urique River, there are but three months in the year when the sunshine reaches the river. The nearly vertical vein of copper, gold-silver ore is well exposed on both sides of the river and is a fine example of a strong vein in the older rocks, at the lower elevations, and of a diminishing vein as it passes into the upper, newer formations.

The veins of the Sierra are as varied as the topography. They range from quartz stringers to massive veins over 100 ft. thick, as at Guadaloupe y Calvo; breccia zones of all thicknesses; pipes or funnels; country rock mineralizations as at Mulatos, where gold has been mined for a distance of four miles; lime-porphyry contacts, as at the Liuvia del Oro, where the ore is quartz, and the historic Bahuarachic, a basic copper ore.

The great values that the Spaniards obtained came from the oxidized zones and the secondary enrichments. The primary sulphides and the water that come with depth were always insufferable obstacles for them. There are a great many veins that have never been examined, of which no samples have been taken, no shots put in, or test pits sunk. Systematic exploration has not been attempted. It is a most attractive field for the prospector who will get out himself and work, and not wait for some peon to bring in samples. It is probable that some of the *antiguas* would be profitable under present metallurgical practice. The great difficulty is in installing machinery, heavy parts required for large operation having to be dragged at great expense over the mountain trails. Perhaps the airplane will do this later.

Primitive Methods of Treatment Employed

The Spaniards divided the ores into *fuegos* (fire) and *azogues* (amalgam). The former were smelted in *vasos*, small reverberatory furnaces peculiar to Mexico, built of sun-dried brick and fired with wood. The ore, oxidized or roasted, with sufficient lead is liquated on the hearth, then slagged and drawn off. A current of air is blown over the molten lead, leaving the silver, which must be further refined in a cupel. The sulphides and the poorer oxides are treated in a small shaft furnace a foot or two feet square and from two to four feet high. These are often built in a wall. The furnace is tapped in front and blown from behind, a block of rhyolite with drill hole through it serving for tuyère. The bellows, one or two, is operated by men. Sometimes a man will lie on his back and move a small vertical bellows with each foot. It reminds one of possibilities in slave days.

Later the *caldo* and the *patio* were used, and one still sees small hypo leaching plants operating. The Americans used pan amalgamation extensively, first free, then with a salt roast. This was followed by cyanide plants. Concentration augmented as now by flotation would be successful at many of these mines, but there is always the problem what to do with the concentrates. Rarely are they rich enough to warrant the expense of shipment. The further treating of sulphides of iron, lead, zinc, and copper combined offers another problem. The favorite method of treatment by the *antiguas* was by the arrastre, and this is the first evidence that one is near an old mine. The arrastres were of all sizes, ranging from the small hand affair to those driven by horse or water power. They were simply large pieces of hard rock dragged around on a circular rock floor, the gold and silver oxides and chlorides being amalgamated with quicksilver. The sale of mercury was a prerogative of the Spanish crown.

The Spanish first saw the Mexican coast in 1519. In the fall of 1521 they were in complete possession of what is now the City of Mexico. The following winter silver was found in the neighborhood of the present *mineral* of Tasco. Guanajuato came in 1526, Pachuca in 1524, Zacatecas in 1546, and Indé and Santa Barbara in 1547. The present site of Chihuahua was probably reached in 1539.

The conquerors crossed the mountains south, and in 1532 two brigantines sailing from Acapulco reached the Gulf of California. Durango (Guadiana) was founded in 1563, after considerable fighting, and the Sierra was crossed at Topia. In 1628-30 Batopilas, Urique, Guazapares, Chinipas and other camps were found. This region has probably produced a thousand million ounces of silver, including the gold at its silver value. Guadaloupe y Calvo was discovered in 1835 and produced nineteen million in ten years, and by 1848 had produced thirty million. Ocampo (Jesus Maria) was found in 1811 and was operated at its best when affairs in the south were at the worst. In eleven years the Santa Juliana produced thirty-nine million ounces. The Santa Eduvigis produced in a few years eleven million. This mine is in a breccia zone. The vein at the surface was 15 ft. thick and in from 100 to 200 ft. in depth it opened into the *Plaza de Gallos*, 60 ft. wide and 400 ft. long. Below the vein trimmed down to 15 ft. in width and a length of 350 ft.

There are several important mining regions in the south: Topia, San Andres de la Sierra, San Dimas, Hostoti-Paquillo, and others. Humboldt called the Chihuahua-Sonora region the world's richest in silver and gold.

With all the troubles that occurred between the Spaniards themselves, between Jesuits and Franciscans, and in the local Indian uprisings, the great one in the latter part of the seventeenth century, the many Apache raids, extending as far south as Zacatecas, on one side, and Hermosillo on the other, and the forty-odd revolutions in the last century, it is no wonder that there are many fascinating romances of lost mines: El Naranjal, Gloria Pan, Tyopa, and others.

Mining Operations Largely Paralyzed Since Revolutions Began

The recent revolutions stopped all foreign mining in the Sierra. The natives continued to work in a small way, not only their own mines but others, as they had to sustain life. In some cases the owners themselves destroyed the exits to save the ore that was ready to be brought out. Some of the plants are a complete wreck; others are in a fair state of preservation. There is one active mining region in Jalisco. Dolores, in the extreme north, has started with a full crew. Batopilas is employing about a hundred men. Otherwise there is an almost complete paralysis in the Sierra Madre. The people are extremely poor now—in the fall of 1921—and except for the few more fortunate they are living on green corn and wild herbs. The ordinary corn tortilla and beans are not to be had. Fortunately, there has been plenty of rain and a good crop is ripening.

Along the railroads there is a change in the ore business. Formerly the natives operated many small mines. They are wonderfully adept at sorting ore and shipped a considerable tonnage of high-grade siliceous ore. The Americans milled the low-grade and shipped their high-

grade to the smelters. The principal ore on the market was quartz. The smelting companies protected themselves by buying flux mines, generally large bodies of low-grade iron-lead carbonate found along or near limestone-eruptive contacts. These mines have developed wonderfully. Milling has so improved that little siliceous ore is now shipped.

The natives are working but little. The consequence is a material advance in the charge for smelting basic ore. Lead-silver ores, unless of high grade, are unprofitable. The natural outcome is the development of the richer milling ores of the Sierra.

Prospecting has ceased in the United States. The mines that are easier to work were found long ago. The mining laws make it possible for speculators and men who have nothing, to hold for long periods of time claims that might otherwise be developed. Little money is ventured in the search for mines. Most of the various exploration companies are seeking developed mines.

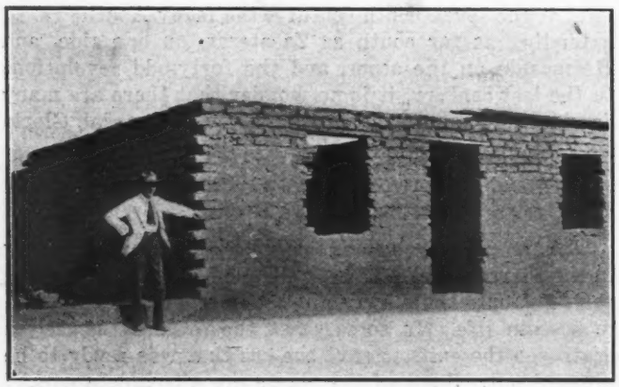
Mexico is richer in mineral than this country, and the Sierra Madre is the richest portion of the country. Its inaccessibility has, so to speak, held it in reserve. With common labor at 75c. per day, as it is now, a given sum of money will do three or four times as much exploring or development as it will in the north.

Filter-Cake Tailing Makes Good Building Brick

BY DONALD F. IRVIN

Written for *Engineering and Mining Journal*

During the last administration, a national statute was enacted in Chile, providing for certain obligatory regulations governing the character of houses for workmen in mining camps. This "Workmen's Housing Act" is directed largely against the generally unsanitary shacks now found in most camps, and encourages the use of substantial construction, such as adobe brick.



HOUSE UNDER CONSTRUCTION USING BRICKS MADE FROM FILTER CAKE

In the nitrate districts, corrugated iron, or *calamina*, construction has been the usual type heretofore, but is generally disliked as being expensive and poorly adapted to the climate, as it is too hot in the daytime and too cold at night.

It happened that some nitrate operators near Sierra Gorda, in the Antofagasta district, found it necessary to provide workmen's dwellings in accordance with the law mentioned, and at the same time (1920) they were tramming to the dump discharged filter cake containing about 12 per cent moisture from their drum-filter installation.

Resolving to kill the proverbial two birds with one stone, they set to making adobe bricks from their filter dump. The results were so satisfactory that they stopped tramming the filter cake to waste, and put an *adobero* to work, making bricks as fast as the cake fell from the scraper of the filter, after most of the original dump had been converted into adobes. The filter cake, which is mostly clay, with some sand, contains small residual amounts of nitrate and salt, and is molded in the time-honored manner of the *adobero*. Besides quickly drying very hard and smooth, the resultant bricks are easily set by masons, and a building made of them is much cheaper than the alternative of a *costra* (clod) wall, plastered with mud, or the usual adobes, which require considerable labor in preparing and mixing the dry material.

As an outer finishing coat, a thin layer ($\frac{1}{2}$ to $\frac{5}{8}$ in.) of cement grouting material and sand is plastered over the adobe wall, thus providing excellent protection against water or casual rainfall.

Many thousands of adobe bricks were made, and a number of dwellings as well as various storehouses and other structures were built from them at this plant. It is conceivable that the same use might be made of filter-cake tailing elsewhere, at least where the discharged cake is uniform and moderately moist.

This information is offered in hope that it may suggest such an economy at this time, when further economies are the aim of every one responsible for the course of mining operations.

Radium Production in Czecho-Slovakia

There is a large radium content in the uranium ore found at Jachymov, in Bohemia, near the frontiers of Saxony, according to Trade Commissioner Fernald L. Breed in *Commerce Reports*. Although the radium production in the United States is greater as to quantity, the ores of Jachymov are richer in quality. The known supply of radium in the Jachymov district will last for twenty years, at the present rate of production. As there are three large mines which are not yet prospected as to depth, and in which the veins of ore widen as they are followed deeper, it is certain that the mining of radium will continue for much more than twenty years at Jachymov.

The Jachymov mines passed in 1912 into the possession of the Austro-Hungarian government. They have now become the property of the Czecho-Slovak Republic. The annual quantity of radium produced amounts to about two grams. The net profits to the government in 1913 were about 1,000,000 crowns. The net profit anticipated for the current year is about 3,500,000 crowns, which, of course, has less foreign exchange value than the pre-war profits. The price of one gram of radium in the home market in 1913 was 588,000 crowns. Today the price of one gram is about 10,000,000 crowns. As the earnings from the radium mines of the republic are looked upon as a possible source of much profit to the government, projects are under way for electrifying the shafts and mill houses, as well as enlarging and modernizing the entire plant. At present the equipment at Jachymov is somewhat primitive. About 100 workmen are employed in the different parts of the establishment.

There are several byproducts of considerable importance. Uranium dyes are produced, eleven workmen being employed in the dye factory. A radio-active watering place is also being built near the mines.

Oatman Today

Conditions Gradually Improving in Arizona's Principal Gold Camp—Costs Lowered Somewhat But Wages Still High—Skilled Labor Supply Ample—Diamond Drilling Gaining Favor—Operating Data

BY W. F. BOERICKE
Written for *Engineering and Mining Journal*

THE CAMP OF OATMAN, Ariz., is situated about twenty-seven miles southwest of Kingman, on the Santa Fé railroad. It is reached over a good automobile road from the last-named town, being part of the National Old Trails Road, and dozens of tourists drive through daily. The magnificent mountain scenery over the Black and River ranges makes it well worth while to attempt the steep grades even with a flivver, though an alternate route is offered by way of the Topock and Needles.

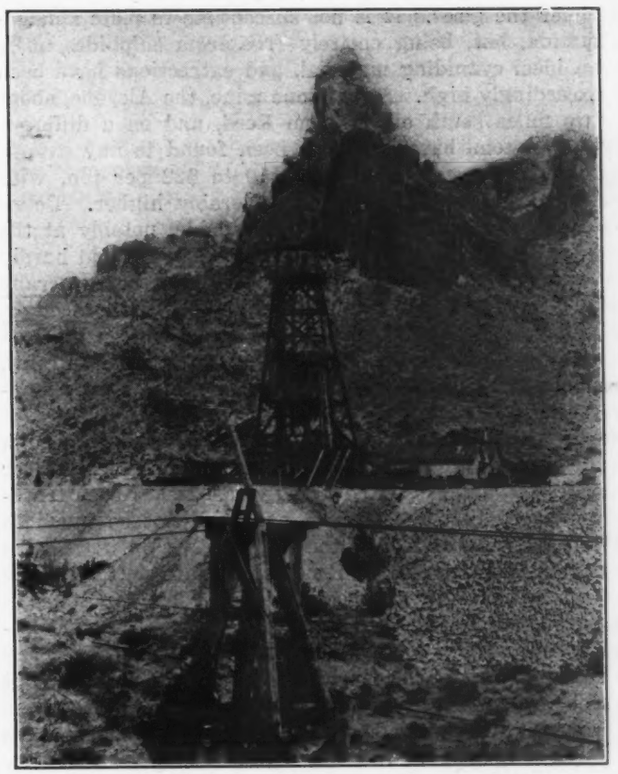
Oatman itself is an anomaly in mining camps. To an engineer accustomed to the rude frontier mining towns of the West, it comes as a shock to find a village of tolerably substantial buildings, a water system, electric lights, and every evidence of law and order. This is undoubtedly due to Oatman's being the pioneer dry camp of the West, with a strict taboo on saloons, gambling houses, and the usual accompaniments. Although the fire in June gave a hard blow to the place, coming as it did when gold mining was still struggling against high costs and meager profits, evidence of it has been largely removed through the energy of its citizens, although the camp has not been entirely rebuilt.

Communication with the outside world is effected entirely by automobile. The fare to Kingman is $5 each way. Stages leave daily in the morning, making the trip in about two hours. The camp is supported principally by the Tom Reed and United Eastern mines. These have been steady producers, and employ about 200 men between them. Besides these, the United American and Oatman United are working, and a number of other companies are prospecting in a small way, some of them diamond drilling.

GEOLOGY OF THE DISTRICT

The geology of the district has been described by F. C. Schrader in Bulletin 397 of the U. S. Geological Survey, now unfortunately out of print, as well as in a number of excellent articles in the technical press. Briefly, the gold occurs in fissure veins resulting from a series of fault movements in the "green, chloritic andesite" of Schrader, which are generally overlaid with a capping of Tertiary volcanics. These veins trend to the northwest, and dip steeply to the northeast. The filling is mainly quartz adularia, with a small amount of calcite. The veins vary considerably in width; at the United Eastern the vein was reported to be at one time 55 ft. wide, but this width is not maintained for any distance. The walls are not especially well defined; the hanging wall is usually the stronger, and has the best values in the oreshoots. Underlying the green chloritic andesite is the older andesite, and below it the pre-Cambrian granite, which is prominent in the northern part of the district, notably at Katharine.

Although it seems established, from developments at the Tom Reed, that the veins themselves extend into the older andesites, the values in the oreshoots upon entering this formation have generally been disappointing, and the conclusion seems justified that the profitable ore deposits will be found in the later formation. However, considerable prospecting is being done



BIG JIM HEADFRAME IN CENTER; RHYOLITE DIKE AND "ELEPHANT'S TOOTH" BEHIND ANDESITES, IN BACKGROUND; AERIAL TRAMWAY STATION IN FOREGROUND

in the earlier formation, and the conclusion may be found to be in error.

The oreshoots are often of considerable extent, reaching as much as 1,000 ft. in length and depth, and sometimes extending clear across the width of the vein. They frequently occur in lenses paralleling each other between the walls.

TOM REED VEIN OPENED FOR OVER THREE MILES

The main vein of the district, the Tom Reed, on which the two principal properties are located, is of extraordinary persistence and length, and has been opened up for a distance of over three miles. This has given rise to the impression that Oatman is a one-vein camp. However, recent developments on the Hammond vein by the Oatman United, which roughly parallels the Tom Reed on the north, give considerable encouragement to the belief that other orebodies may be found on veins of the same age and character as the Tom Reed.

Faulting is common, and displacements are often very

large. The history of the apex suit between the United Eastern and the Tom Reed, involving the influence of the Mallory fault, is too recent to demand much discussion.

Elephant's Tooth a Landmark

Paralleling the vein systems, and situated about a half mile to the northwest, is a very prominent rhyolite intrusion, culminating in a gigantic spire known locally as the Elephant's Tooth. It is believed that this intrusion had important genetic effect on the gold, and that the gold came in with it and was given off by it to the underground circulation.

The gold is found in the quartz adularia gangue, in an extremely fine condition, generally invisible even under the glass. It is not susceptible to plate amalgamation, but, being entirely free from sulphides, it is an ideal cyaniding material, and extractions have been exceedingly high. At only one mine, the Alcyone, about two miles south of the Tom Reed, and on a different vein system, have sulphides been found to any extent. Average values range from $10 to $22 per ton, with some high-grade portions considerably higher. Below $10 there is a large tonnage available, notably at the Gold Road mine, but with present costs this can hardly be classed as ore. The gold content does not generally vary inversely with the width of the oreshoot, as might be expected, but the wider veins often contain the best ore. Such ore is found in a quartz of a peculiar faint, ribbon-like, banded structure, often stained with manganese.

Approved methods of prospecting are to sink through the capping of the Tertiary volcanics and into the later andesites, and crosscut for the vein. It has been truthfully said that the trouble has been not so much to find the vein, as to find the oreshoot within it. Shafts usually have two compartments, and are 4 ft. 6 in. by 9 ft. in the clear, which gives ample room for a bucket or cage in one side, and a ladderway, pump and ventilating pipes in the other. Some smaller shafts have been sunk, in which the ladderway is cut down to 2 ft., but this makes the space very cramped. Its advantage is a saving in timber cost. All the larger shafts have three compartments. When ore is found, the two compartments are enlarged by raising from the bottom to a full-sized working shaft. This involves considerable effort and loss of time, but is usually justified.

Cost of Sinking and Drifting—Other Data

All shafts are timbered and lagged solid from top to bottom; 6 x 6-in. timbers are used in the small shafts, and 8 x 8-in. timbers spaced 6 ft. apart in the larger, with 2 x 12 in. lagging. The cost of sinking is usually given as $40 to $50 per ft., and is customarily done on contract. As the shafts are practically dry, the water problem is not troublesome, particularly down to the 500 level, and bailing is employed instead of pumps for the small inflow. The usual custom is to contract for the labor, powder, and timber-setting, the company furnishing equipment, power, and timbers. In such contracts the cost is about $20 per ft. The speed of sinking will, therefore, have an important bearing in cutting down the overhead, and so getting a low cost per foot. Most of the shafts are vertical, but some inclines have been sunk at steep angles. Buckets are used in sinking, with crossheads in guides. The operating mines use skips for hoisting ore.

Drifting costs vary from $8 to $15 per ft. With a surplus of labor and good top equipment, the lower figure is more usual. Drifts are generally 5 or 6 ft. wide, and arched to 6 ft. high. Timbering is not usually necessary in development drifts, and the ground, though ragged, stands fairly well. When opened up along the vein, however, conditions are very different and the cost of timbering to keep the drifts open when stoping has begun is high. Equipment is light for prospecting. Buckets are trammed by hand over 8-lb. rails to the shaft. End-dump cars are used at the operating mines, and the ore is dumped on a grizzly at the shaft, where it drops into an ore pocket.

Overhand stoping methods are used in mining, with chutes to the lower levels. Filling is obtained by running raises into the hanging wall for waste, and this involves considerable expense. The ground breaks well, and there is not much trouble with blocked chutes. Stoping drills, known among the miners as "wiggle-tails," are used with solid steel. Both bull bits and four-point bits are popular. The dust problem has been attacked by using water sprays and having the men wear respirators.

Working conditions are made somewhat difficult by high temperatures and humidity underground. On the lower levels this becomes particularly oppressive, unless relieved by raises or connections to afford natural ventilation. On the bottom level (1,060) of one of the large mines the temperature is about 90 deg., and the water temperature reported at 103 deg. Ventilation, where possible, is obtained by natural air currents through raises, supplemented at dead headings by blowers and ventilating pipes. Booster fans are introduced at frequent intervals. The men work stripped to the waist on tramming and mucking. Change houses and showers on the surface are, of course, a necessity in even the smallest mines. Where connections have been made underground with other mines, conditions are much better.

Water Easily Handled in Most Mines

Pumping, except at the deepest levels, is not much of a problem. With prospects, if bailing is not resorted to, a small duplex pump is connected to the air line. This is uneconomical, but about the only resort where power is not available. The average amount of water pumped is 5,000 to 7,000 gal. per twenty-four hours. Ample water for domestic purposes is piped from nearby springs.

Gas engines are generally used for power, though the larger mines have electric power from an oil-burning plant at Kingman, that of the Desert Power Co. Rates are regarded as high, but this power is more economical for large-scale operations than are oil engines, aside from the question of greater convenience and freedom from break-downs. Present power rates are $0.0355 per kw.-hr., subject to discount for quantity consumption.

Oil Engines Necessary for Small Plants

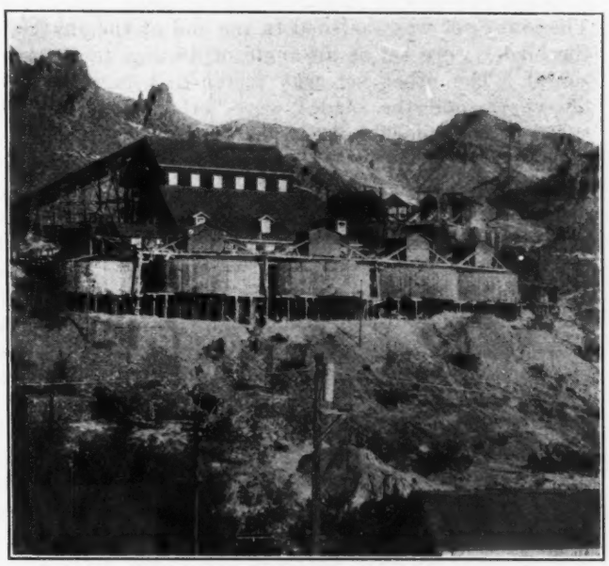
At one of the smaller operating mines, where there was a long and steep haul to the plant, over 20 per cent grades, the following data were given regarding the operation of a 50-hp. compressor (240 cu.ft.) and a 25-hp. hoist, pulling 700 ft. The cost of fuel oil (tops) is given at 18c. per gal. delivered at mine: Oil consumption, hoist, 2½ gal. per hour; oil consumption, compressor, 7 gal. per hour; lubricants, 1½ gal. per eight-hour shift at 90c. per gal. Total cost of fuel and lubricants per shift, $15.75.

Although the advantages of the electric drive are recognized, the initial cost of equipment and transformers is high, and for isolated plants the oil engines are a necessity.

Supply of Experienced Labor Ample at Present

Labor conditions are good. Owing to the shutdown of the copper mines, no scarcity of experienced men is to be recorded. At present there are more men than jobs, but a considerable proportion are "floaters," and there is no serious unemployment. The present wage scale is $4.50 for stope men, $5 for shaft men and blacksmiths, and $5.50 for drill men and hoist men. A cut of $1 was put into effect some months ago, which was accepted by the men without much trouble. For contract work in the shafts a bonus of $1 per shift is allowed by the contractor. Living costs are not notably higher than in places much more accessible to the railroad. Meals cost 50c. and are of good quality.

Although the present wage scale is high in comparison with that paid in the eastern mining districts, there appears to be no immediate intention of the



TOM REED MILL AND CYANIDE PLANT, OATMAN, ARIZ.

operators to cut again. In the past it has been difficult to get good men at Oatman in competition with the copper mines, and the operators are unwilling to take advantage of the opportunities presented by the present situation. There is no union.

The cost of timber has been a serious item of expense in shaft sinking. Although it can be bought f.o.b. San Pedro at a reasonable figure, freight rates are high, and the cartage into Oatman is about $12 per thousand. In small quantities it is quoted at $80 per thousand delivered, but carload rates are much less. Considerable saving could be made by the small operators and those developing new properties by buying both timber and powder in carload lots, but this co-operation is not often possible, because of inability to place orders at the same time.

Diamond drilling is now being tried at several properties to prospect underground, instead of the conventional drifting and crosscutting. The cost is about $3.50 per ft., the operator furnishing air for power. The andesite can be drilled rather easily, and the plan has been indorsed by the larger companies.

Costs of mining and milling are reported as $6 to $9 per ton. They have come down somewhat from the peak figure, and will come lower, but very slowly. Labor is necessarily the chief item, and, as stated, no immediate wage cut is considered. More may be gained by better co-operation and by increasing the efficiency and output per man underground. With a steadier crew this is entirely possible. Costs of supplies, timber, and even power are dependent as much on a lowering of freight rates as on any other single factor. It has already been suggested that co-operative buying of timber and powder by the small companies would result in a substantial saving. There is not much chance for a lowering of power rates, except through an increased use of power by the district generally. These rates are under the control of the state commission, and profits are limited to a reasonable and equitable return on the investment.

Larger Tonnage Awaiting Lower Costs

It is essential, however, for the full development of the resources of the camp and the district generally, that costs should be reduced, as there is a considerable tonnage of ore exposed and available that cannot be worked under present conditions. The famous old Gold Road mine, for example, two miles from camp, is said to have a very large tonnage in sight and is only awaiting better operating conditions before resuming operation.

Oatman, in common with other gold camps during the last few years, has had to combat constantly advancing costs and insufficient and inefficient labor without a compensating advance in the price of its product. With the turn in the times, however, gold mining seems likely to come into its own again, and the camp should take on new vigor. There is considerable optimism in the district over the future, and a well-grounded belief that with its remarkable record of production, large extent of yet unprospected ground, and with the newly awakened interest in gold mining, Oatman will see much activity at an early date.

Copper for Welding Steel

The persistently high cost of labor and material has forced manufacturers to give the keenest attention to every promising source of economy in production. For this, among other reasons, there has been a revival of interest in a unique welding system developed in Great Britain a few years ago, and since put into commercial operation, says *The South African Mining and Engineering Journal*. This system depends upon the fact that if a piece of copper on an iron plate is heated in an atmosphere of hydrogen to the smelting point of copper, the copper will spread over the iron in a thin penetrating film like butter on hot toast. So, if the copper is melted between two pieces of iron it welds them together in an amazingly intimate fashion, the copper film actually working itself in between the crystals of the iron. By this process machine parts which can most conveniently be made in two pieces can be efficiently joined together without the complication of screws. In effect it enables the cheapness of separate manufacture to be combined with the strength and convenience of the solid combination. Steam turbine blades and the cage or body of a high-speed centrifugal governor for small steam turbines are among the articles which have been successfully made by this simple and ingenious process.

Flotation Tests on Zinc Table Slime

Experimental Work Indicates That Much Fine Material Now Going to Waste in Tri-State District Can Be Easily Floated With Naphthylamine-Toluidine Mixture and Copper Sulphate — High Recoveries Secured

BY M. H. THORNBERRY
Written for *Engineering and Mining Journal*

THE EXPERIMENTAL WORK here described was planned and carried out to provide the mine operators of the Missouri-Kansas-Oklahoma zinc district with facts concerning the amenability of their table slime to flotation. An attempt will be made to show that high-grade concentrate can be made economically; also that the concentrate so made will be a distinct addition to that made by usual gravity concentration. The oil and reagent needed should not put a prohibitive cost burden upon the operators. It is, of course, realized that flotation concentrates of any zinc tenor bear a penalty because of the fineness of the product.

The term "table slime" used in this article should not be confused with table sludge. Table slime is the discharge from the tables. This product is sent to the tailing dump in many of the mills, but in the modern plants it is sent to thickeners, after which it is given further treatment. Table sludge is the table feed, and is considered as any product that can be treated commercially and metallurgically on a concentrating table. Reports from two of the modern mills in the district state that approximately 9 per cent of the total mill feed is sent to the thickeners. This figure under normal operating conditions would mean a daily production of 13.5 tons of table slime for a 150-ton mill.

The slime for these tests was obtained from the Dorr thickener of the Golden Rod Mining & Smelting Corporation, Tar River, Okla., was barreled wet, and when received contained approximately 25 per cent moisture. A representative sample of the material gave the following analysis in per cent:

CHEMICAL ANALYSIS OF TABLE SLIME

Zn	13.77
Fe	0.92
CaO	6.83
MgO	5.41
Pb	0.76
"Insoluble"	55.51
Total determined	83.20

A screen analysis of the slime was next made. It was found necessary to screen the wet material because when dried the screen openings clogged, owing to the fineness of the slime. Tyler Standard screens were used, and the results were as follows:

SCREEN ANALYSIS OF TABLE SLIME

On Mesh	Diameter Opening, Inches	Sample Weights	Per Cent	Per Cent Cumulative Weights	Per Cent Zinc
65	0.0082	.....	.....	.....	.....
100	0.0058	9.28	2.25	2.25	2.18
150	0.0041	73.70	17.83	20.08	3.63
200	0.0029	124.50	30.13	50.21	12.17
200	0.0029	205.70	49.79	100.00	15.35

A series of preliminary tests was next made to ascertain the oil or combination of oils and reagents best suited to float the blende in this slime. In making these tests the desired weight of ore was approximated, placed in a laboratory Janney flotation machine, different oils and reagents added, and the effect noted.

After trying many oils, which included pine products, creosotes, coal tars, and special mixtures in combination, with and without different reagents, it was found that the "A.T. Mixture" (a mixture of alpha naphthylamine and ortho toluidine) from the Newport Chemical Co., of Passaic, N. J., when used with copper sulphate, produced such favorable results that it was decided to confine the research work to this combination.

The later tests were all made in a laboratory flotation machine of the Minerals Separation type. The impeller of this machine consisted of a ⅜-in. shaft, to which were fastened two sets of four-blade agitators of 2-in. radius. The lower set was fastened to the end of the shaft and the blades were set at an angle of 45 deg. to the horizontal. The other set was fastened 3 in. above the lower set, and the blades were left horizontal. The speed of the impeller was 1,500 r.p.m.

METHOD OF CONDUCTING THE EXPERIMENTS

The experiments were carried out as follows: A portion of the slime was thoroughly mixed and the moisture determined. A weighed charge of wet pulp containing approximately 700 grams of dry ore was poured into the machine, with sufficient tap water to give the charge a dilution of five parts of water to one part of dry ore, by weight. The machine was started and allowed to run until the charge was well mixed, after which a quantity of oil equivalent to 0.75 lb. per ton of dry ore was added and the agitation continued. Copper sulphate was then added, and the froth skimmed off. That portion of the froth removed during approximately the first half of the test, and while the bubbles appeared to be carrying practically nothing but blende, was designated as the concentrate. That portion removed after the concentrate, and until apparently no blende was carried up with the bubbles, was designated as the middling. The total time for each test varied between fifteen and twenty minutes.

The first series of tests was made for the purpose of ascertaining the minimum amount of copper sulphate necessary to float the blende in this slime. It was found that this reagent produced the best results when added all at one time and after the oil had been added. The results show that 70 c.c. of a 1 per cent solution of copper sulphate produced a very good concentrate and a good recovery. This amount involves approximately a consumption of two pounds of copper sulphate per ton of slime treated.

The concentrate and middling from each test were dried, weighed, and assayed, whereas the tailing from each test was only sampled and assayed. The recovery was calculated in the following manner:

$$\frac{(\text{Weight of Concentrate} \times \text{per cent Zn}) + (\text{Weight of Middling} \times \text{per cent Zn})}{\text{Weight of charge} \times \text{per cent Zn}}$$

In the table which follows are results which are representative of the large number of tests performed in this work. Every result shown in the table has been

checked at least once, and some of the results have been checked as many as three times.

RESULTS OF EXPERIMENTAL FLOTATION WORK

Test No.	Oil: Amount, Drops	Oil: Kind	Reagent: Amount, C.C.	Reagent: Kind	Concentrate: Wt. Grams	Concentrate: Per Cent Zn	Middling: Wt. Grams	Middling: Per Cent Zn	Tailing: Per Cent Zn	Recovery, per Cent
1	8	A.T.	30	$CuSO_4$	48	54.70	39	41.44	8.12	44.0
2	Drops	Mixture	40	in	98	54.91	20	43.60	5.09	65.0
3	in	in	50	every	120	57.91	27	43.30	2.34	84.0
4	every	every	60	test	130	58.74	25	40.92	1.31	88.5
5	test	test	60		130	58.33	27	39.16	1.40	88.0
6			70		150	57.08	17	26.31	1.22	92.0
7			70		150	58.84	12	32.43	0.58	95.0
8			70		148	58.64	14	31.50	0.61	95.0
9			80		150	58.42	17	23.41	0.60	95.0
10			90		149	58.70	16	22.81	0.59	95.0

Edward H. Robie, in his paper on "The Use of Naphthylamin and Xylidin in Flotation," *Engineering and Mining Journal*, Vol. 108, No. 18, page 731, makes the following statement: "When operating with X-cake-xylidin, economy requires the use of the largest possible amount of return water. Flotation operators have found that when oils are used in a closed circuit only a little less oil is required than when the mill feed is made up entirely of new water. The insoluble parts of the oil are probably lost entirely, and only a part of the soluble constituents is returned to the frothing cells with frothing properties unimpaired. With X-cake, this has not been found to be the case. Whatever amount is returned in the water from concentrate or tailing seems just as efficient as ever. Apparently little or no deterioration occurs in settling ponds, although the water gradually turns a dark brown. Considerably less of the agents under discussion are therefore required if the make-up water is kept at a low proportion of the total."

To verify the above statement several series of tests were run in the following manner:

One of the weighed charges was run as previously described. This test has been designated as No. 1-A. The water from test No. 1-A was siphoned off and used for the next test. No oil was added, but the same amount of copper sulphate was found to be necessary. This test was called No. 2-A. The water from test No. 2-A was siphoned off and used in like manner for test No. 3-A. The froth which formed in test No. 2-A had the same characteristics as that formed in No. 1-A. The froth in test No. 3-A, although it did not appear to be as stiff as in tests No. 1-A and 2-A, carried practically as much blende. One set of these results is tabulated below.

EXPERIMENTS TO SHOW PERSISTENCE OF A. T. MIXTURE

Test No.	Oil: Amount, Drops	Oil: Kind	Reagent: Amount, C.C.	Reagent: Kind	Concentrate: Wt. Grams	Concentrate: Per Cent Zn	Middling: Wt. Grams	Middling: Per Cent Zn	Tailing: Per Cent Zn	Recovery, per Cent
1-A	8	A.T.	70	$CuSO_4$	153	57.00	25	12.43	1.01	95
2-A	None	Mixture	70	$CuSO_4$	148	57.71	26	21.76	0.81	95
3-A	None		70	$CuSO_4$	149	58.22	18	21.86	0.92	95

Conclusions Based on the Test Work

1. Copper sulphate is the main factor in the concentration of the blende in this slime by flotation.

2. The "A. T. Mixture" of the Newport Chemical Co., of Passaic, N. J., in conjunction with copper sulphate, was the oil best suited to float the blende in this slime. The amount of oil used in each test is equivalent to 0.75 lb. per ton of dry ore.

3. The best results were produced by 70 c.c. of a 1 per cent solution of copper sulphate, this amount being equivalent to approximately 2 lb. per ton of dry ore.

4. Small amounts of copper sulphate added at intervals did not raise the blende as well as when added all at one time.

5 The oil must be added first. When the copper sulphate was added to the charge before it was poured into the machine, practically no blende floated.

6. The consumption of oil may be lowered considerably by returning the water from the concentrate and tailing to the flotation cells.

German Potash Loses Markets

The German Potash Syndicate has issued figures in its semi-annual statement placing Germany's production of potash salts during the first six months of 1921 at 4,454,261 metric tons, or 497,373 tons of pure potash, according to William T. Daugherty, Assistant Trade Commissioner, Berlin, in *Commerce Reports*.

The sales from this production during the same period, according to the syndicate, amounted to 1,546,353 tons of potash salts, or 366,633 tons of pure potash. The difference between the figures of production and those of sales is due to the loss of weight undergone in the process of working up. Most of the sales (1,408,911 tons of salts, or 333,281 tons of pure potash) were made in the domestic market. The remainder (137,442 tons of salts, or 33,352 tons of pure potash) was sold in relatively small quantities, as compared with before the war, to The Netherlands, England, Czecho-Slovakia, Austria, Italy, and Spain.

During the year 1920 Germany produced 11,386,439 metric tons of potash salts, of which 4,313,325 tons was sold, and sales of pure potash amounted to 923,643 metric tons.

The loss of foreign markets, which before the war absorbed 46 per cent of Germany's sales, is attributed in a large measure to the competition resulting from the acquisition by France of the important deposits of Alsace Lorraine under the terms of the Treaty of Versailles. During 1920, out of a total production in the Alsace mines of 1,061,197 metric tons of potash salts, 450,000 tons was sold to France, 327,000 tons to the United States, 117,000 tons to Belgium, and 92,000 tons to England. Furthermore, the former pre-war market in Poland, and through Poland to the East, has been cut off by reason of political and economic conditions in that quarter.

Of the total German production of 4,454,261 tons of potash salts during the first six months of 1921, there was a yield of 2,535,451 tons of carnallite (7 to 12 per cent salts), 1,828,959 tons of kainite (12 to 20 per cent salts), and 89,852 tons of sylvanite (over 20 per cent salts).

In the several districts yielding potash the production during the first six months of 1921 was as follows:

GERMAN POTASH PRODUCTION DURING FIRST SIX MONTHS OF 1921

Districts	Potash Salt Metric Tons	Pure Potash Metric Tons
Hanover	1,401,452	159,160
Stassfurt	1,024,836	101,909
Halle-Mansfeld	594,312	58,259
Sued-Harz	806,245	105,802
Werra	627,416	72,243
Totals	4,454,261	497,373

Hoist for Men and Supplies at Arizona Copper Mine*

BY R. E. DONOVAN

Written for *Engineering and Mining Journal*

THE United Verde Copper Co., at Jerome, Ariz., has recently installed new equipment on the 500-ft. level of its No. 6 shaft, for rapidly hoisting and lowering men. Supplies can also be taken into the mine down this new shaft.

The United Verde mine is 2,400 ft. deep, and has extensive workings. At present, about 1,800 tons of sulphide ore, containing 6 per cent copper, is mined per day. Approximately 400 men are employed underground on each shift. The length of a shift in Arizona is limited by statute to eight hours from "collar to collar." The law also limits the hoisting speed for men to 800 ft. per minute. With the old hoisting equipment, which consisted of two double-decked cages in No. 4 shaft and two double-decked cages and a "chaser" in No. 3 shaft, each deck holding nine men, forty-five minutes was required to lower a full shift of 400 men. With the new equipment the same number can be handled in twenty-five minutes, or practically one-half of the time formerly required. Also, under the old arrangement, when the shift was ready to come up, men often had to wait twenty to thirty minutes before they could be hoisted. This waiting, done on the company's time, is now eliminated, as the new cage arrives at each station at a stated time and will carry all men waiting at that station. The power loss resulting from making many trips with small loads of men and supplies will also be eliminated, owing to the large capacity of the new cage. The new installation has many safety improvements not found in the old equipment.

Formerly all timber, steel, and supplies had to be transferred at the collar of the shaft, and again transferred to trucks on the different levels. With the new equipment, the standard steel and timber trucks are lowered on the double-decked man-cage and run direct from the shaft to the working place, no unloading being necessary except at the stopes.

No. 6 shaft, which was started over two years ago, extends from the 500 level to below the 1,800 level. It is expected to be completed to the 2,400 level within two years. It will be used exclusively for lowering and hoisting men and supplies. The shaft was constructed by raising in sections of 200 ft. from the 700 to the 500, from the 900 to 700, and so on. Three cubic yards of concrete were used to each foot of the shaft, and each 200-ft. section was concreted separately. The shaft has a hoisting compartment 8 x 13 ft., a counterbalance compartment, a pipe compartment, and a manway. The cost of construction, including raising, trimming, and concreting, was approximately $210 per foot. An adit level, called the "500 surface level," connects the collar of No. 6 shaft with the surface buildings and change house. This adit is 1,635 ft. long, timbered, and large enough to permit a pathway on one side of the standard-gage track. The track is provided with a third rail, and both the standard-gage electric trolley and the narrow-gage electric-storage battery locomotives haul supplies through the adit.

The hoist room is 120 ft. from the center of the shaft. It is 44 by 45 ft. and 26 ft. high, is well lighted, has concrete walls, and contains a hoist and motor. The cableway, 140 ft. long, is at an angle of 32 deg. above the horizontal. The sheave wheel is 70 ft. above the collar of the shaft. The cableway is about 10 x 7 ft. in cross section. An iron ladder is put alongside the cable.

Opening off the hoist room on the south side is the motor generator room, which is 20 x 32 by 13 ft. in height, has concrete walls, and contains two motor generator sets which change alternating current at 2,200 volts to direct current at 250 volts. The equipment supplies power for all underground haulage motors, including the charging panels for the storage-battery locomotives on the intermediate levels. It also furnishes power for small fans which are connected to the trolley circuit and used for ventilating purposes.

The hoist, which was put into operation on March 16, 1921, has a single cylindrical drum, 12 ft. in diameter, holding 2,500 ft. of 1¾-in. extra plow-steel rope, in two layers. The drum is coupled direct to a counterbalance reel, which has a hub diameter of 6 ft. 1 in. and a rim diameter of 12 ft. This reel will hold 1,920 ft. of ½ by 5-in. seven-strand flat rope.

The maximum rope speed is 800 ft. per minute, with an acceleration period of six seconds and a retardation period of five seconds. The flat cable passes over two 8-ft. sheaves, one being at the lower end of the inclined cableway and placing the flat rope in the same plane as the round rope. The round rope passes over a 10-ft. sheave, which varies from the ordinary sheave in that the rim is fastened to the hub by disks of ⅜-in. plate. The brakes are of the parallel motion, gravity, post type, set by a deadweight and released by a hydraulic oil-thrust cylinder. The hoist is operated by a 350-hp., three-phase, 60-cycle, 2,200-volt, round-wound induction motor, with liquid rheostat control. The gear ratio is sixteen to one. There is no clutch on the hoist.

The cage weighs 13,000 lb. It is a double-decked cage, 24 ft. high, each deck being 6 ft. 8 in. by 12 ft. 7 in., and accommodating between 120 and 140 men. Two 18-in. gage tracks give each deck a capacity of four cars. The cage is fitted with double gates, which have offset hinges and prevent the gates from swinging outward. It is also equipped with the ordinary safety dogs and, in addition, has two chains from the cage to the cable above the clevis. The weight of the cage and men is balanced by a counterweight of 31,500 lb. The varying weight of the cable in the shaft is offset by the varying diameter of the counterbalance reel. When not handling a full load the counterweight is too heavy for the cage. To offset this disadvantage, a car of scrap drill steel is run on the lower deck and only one deck is used for ordinary service.

The hoist is provided with an over-speed safety device, which breaks the power circuit and applies the brakes in case the cage should attain a speed of more than 800 ft. per minute. The shaft is also provided with limit switches at both the upper and lower extremities. These also cut off the power and apply the brakes in case of over-winding or lowering. All station gates have lock-switch contacts, which prevent the cage-rider from giving the signal before the gates are closed.

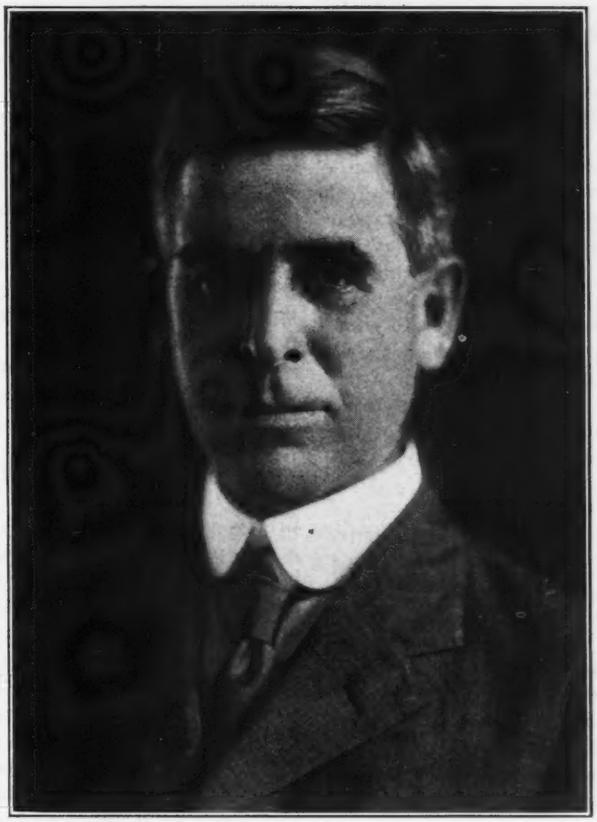
A substation has been cut 10 ft. below the collar of the shaft, with a concrete stairway leading to it from the level. This will enable both decks of the cage to be loaded at the same time. A room has been excavated and concreted alongside of the shaft, and contains a crane for changing cages when repairs are needed. An extra cage will be kept in this room.

*Published by permission of the Director, U. S. Bureau of Mines.

Geologists of Note

Frank L. Hess

FRANK L. HESS was born in Streator, Ill., which, at that time—Sept. 4, 1871—was a small coal-mining town. On his father's side his ancestors were early German and Dutch settlers and Revolutionary soldiers. On his mother's side he was descended from German, French, and Scandinavian ancestry. His father, a physician, had a taste for various sciences, particularly geology, and from him young Hess acquired a love for rocks and minerals. The dumps of the coal mines offered a good opportunity to the juvenile collector, as the shales from the roof contained many ferns and other plant forms and in the waste coal there was to be found a little pyrite and rarely a pyritized gasteropod shell. The glacial drift afforded some corals, and along the little Vermilion River were a few outcrops of thin fossiliferous limestones. As a small boy Hess tramped the neighborhood over hunting such occurrences, and the desire to become a geologist possessed him from the time he was eight or nine years old. But in this community, with no mineral resources other than coal, clay, and a little poor sandstone, there was nothing to inspire the belief that a living could be made in such a profession, so after going through the common and high schools of the place he farmed for a time in Minnesota and Illinois, and was teller in a bank, later moving to California and ranching between Visalia and Tulare. While at this place he became familiar with metal mines, and, finding that a living might be made through the practice of geology, the old desire again became strong and he left the ranch and went to Stanford University. While there he worked for the U. S. Geological Survey during two summer vacations. To get work one summer he had to take a job as assistant packer; he took care of the nine head of horses before breakfast, did eleven hours of work as a geologist, and again took care of the stock after the day's work was over.



FRANK L. HESS

In 1903 Hess was graduated from Stanford, was married to Miss Eva Roseberry, and went to the Nome region, Alaska, as a field assistant on the Survey, and he has been associated with that organization from that time. He spent three seasons in Alaska studying the gold deposits of the Nome, Council, Fairbanks, and Rampart regions and the tin deposits of the York district, and later he studied many of the mining regions of the United States, and made a specialty of the rare metals. His studies and publications have covered tungsten, radium, and other of the rarer metals, the rare-earth metals, gold, silver, tin, nickel, gypsum, magnesite, graphite, arsenic, oil, and other deposits. This work has been of such a nature as to give him an unusually wide variety of geological experience, and the research has been mostly among the less known, and therefore scientifically more interesting, minerals, but those which are of the smaller money value. Geologists of the U. S. Geological Survey are permitted to engage in private professional work outside of the United States, and Mr. Hess spent the winter of 1919-1920 in Bolivia examining tin and tungsten deposits for one of the large American mining firms and for local Bolivian and Chilean companies. Owing to his interest in the U. S. National Museum, in Washington, Mr. Hess was made Honorary Custodian of Rare Metals and Rare Earths, and has assisted in building up at that institution what is probably the best collection of tungsten and other rare-metal minerals in the world.

Mr. Hess has published about two hundred papers on various geological and economic subjects, and at the last meeting of the Society of Economic Geologists at Wilkes-Barre he presented a paper, "Some Unique Bolivian Tungsten Deposits." He belongs to the American Institute of Mining and Metallurgical Engineers, the Society of Economic Geologists, the Washington Academy of Sciences, the Geological Society of Washington, and is a member of the Petrologists' Club. Among his writings are the following: "The Magnesite Deposits of California," 1908; "The Gypsum Deposits of California," 1910; "A Bibliography of the Geology and Minerology of Tin," in collaboration with Eva Hess, 1912; "Colorado Ferberite and the Wolframite Series," in collaboration with Waldemar Schaller, 1914; and "Tungsten Minerals and Deposits," 1917.

The "Journal's" Editorial Dinner

Gold Medal Awarded to Walter Fitch, Jr., Co. for Breaking World's Shaft-Sinking Record—Speakers' Program Includes a Great Diversity of Topics—Aids for Improvements in Metal Mining Proposed—Standard Ore Sale Contracts Urged

GOOD FELLOWSHIP, friendly criticism, sincere approval, and assurances of co-operation were in evidence at the editorial dinner of *Engineering and Mining Journal*, held at the Harvard Club, New York, on Thursday evening, Jan. 5. The guests, numbering forty-three, included members of the editorial staff and contributors. The dinner, in addition to being in the nature of a conference, was also the occasion of the awarding of the gold medal for the breaking of the world's shaft-sinking record to the Walter Fitch, Jr., Co., of Eureka, Utah.

In his opening speech as toastmaster, J. E. Spurr said that he had looked forward to such a gathering of the editorial group with great pleasure. He spoke briefly concerning the early history of the *Journal*, its place in the mining industry, and the part which is played by the editors and contributors in the preparation of the paper. He gave interesting figures to show the manner in which the various developments and activities of the mining industries were covered in the *Journal* during 1921, and called attention to the number of correspondents (about fifty) in various parts of the world, and the importance of the market reports.

Need for Standard Sale Contracts

In introducing the first speaker, Dr. A. R. Ledoux, Mr. Spurr referred to him as "our sage and Nestor of engineers." Dr. Ledoux said: "The shippers of ores or metals are largely not represented in New York. They are increasingly abroad. The future of the industry in the East at least is not to handle material originating in this country, which will be fabricated in the West, and New York and the Eastern coast is going to depend for supplies on imports, and these people in foreign countries don't know how to make contracts."

George J. Young, Western editor of the *Journal*, was the next speaker. Mr. Young said that at one time there was current in the West a conviction that *Engineering and Mining Journal* was owned by the A. S. & R. At another time the labor unions were convinced that the *Journal* was decidedly capitalistic and opposed to labor interests, but all of this has changed. He also spoke briefly on the relation of the *Journal* to the West and to Western subscribers.

Mr. Spurr remarked that the reference to the ownership of the *Journal* by the A. S. & R. Co. afforded an opportune time to introduce one of the men of that company, so he called on Joseph Clendenin. Mr. Clendenin, in giving his opinion of the *Journal*, said that he regarded it as "the representative newspaper in the metal industry." Prof. B. L. Miller, of Lehigh University, was introduced by the toastmaster as the "author of the best book on the geology of South America, because it is the only one." Professor Miller stated that the subject of graphite, which had been assigned him, seemed too dark a subject to discuss during the evening. In addition to having been assigned the topic of graphite, Professor Miller was also asked to talk on mining geology, on which he spoke briefly, and made humorous references to the use of newly discovered appliances for finding ore and petroleum.

S. S. Tuthill, secretary of the American Zinc Institute, the next speaker, pointed out the necessity of protecting American zinc. He said: "We have got to develop mining zinc in our own borders, and if we do not there is going to be no American zinc. This year we made 250,000 tons of American zinc in this country, whereas we should have made 560,000 tons, and I believe we should first take care of ourselves before we worry about anybody else."

Rice Discusses Tunnels

The subject of safety was assigned to George F. Rice, chief engineer of the U. S. Bureau of Mines. Mr. Rice spoke briefly of the work of the Bureau in connection with tunnels for mines and tunnels for vehicles and pointed out that there were certain matters of common interest in the work. Mr. Spurr facetiously remarked that besides being owned and controlled by the American Smelting & Refining Co. and the American Metal Co., the *Engineering and Mining Journal* was also exclusively owned by the St. Joe Lead Co., and accordingly he called upon its representative, I. H. Cornell. Mr. Cornell stated that the marketing of lead in 1921 has been a pretty sad affair. He said that every time he quoted a low price on lead and his competitor got the order he felt disappointed, and every time he quoted a price and got the order himself he was even more disappointed.

Mr. Spurr next called upon H. C. Parmelee, editor of *Chemical and Metallurgical Engineering*. Mr. Parmelee mentioned his brief connection with the *Journal* and related that he had been instrumental in securing Mr. Spurr as editor. The several talks mentioned above were interspersed by the reading of letters that had been received from a number of contributors in various parts of the country, who had been invited to attend the dinner, but were unable to do so.

Westervelt Presents Gold Medal

Mr. Spurr then called upon W. Y. Westervelt, who was chairman of the committee of engineers who judged the awarding of the medal, to present the medal to P. M. White, whom Walter Fitch, Jr., had appointed as his personal representative. Mr. Westervelt outlined the work done by the committee in preparing the set of rules governing the contest, and also pointed out many of the details concerning the work done by the Walter Fitch, Jr., Co. Mr. Westervelt also announced that Mr. Young, Western editor of the *Journal*, will present to the forty-three members of the crew at Eureka silver replicas of the same medal, each man receiving his own silver medal.

Mr. White, in receiving the medal, said that he felt like the Frenchman who had a number of medals, and one man asked him how he came to get them. The first medal, he said, was a mistake, and the other powers naturally followed suit. Mr. White stated that he was no longer in mining, although he had been very much interested in the contest. He closed by saying that he

wished to thank the committee and *Engineering and Mining Journal* on behalf of Mr. Fitch.

Referring to the award of the silver medal, Mr. Spurr said: "It is, of course, a fact that the *Engineering and Mining Journal* is owned and controlled by the American Federation of Labor, and when we announced our gold medal we immediately received word from them that they resented a medal awarded to capital, and that we would not be allowed to go on if we did not also award a medal to labor; so we promptly came back and said we would give a silver medal to every man who mucked out or drilled. We had in mind a small, select crew, but when the picture came we counted them up and there were forty-three. Here are forty-three medals just as big and just as pretty as the gold medal, excepting that they are made from silver—presumably foreign silver."

D. E. A. Charlton was the next speaker, and despite the fact that five topics had been assigned him, he elected to tell a Cousin Jack story relating to high costs.

"Journal" Metal Quotations Extolled

Mr. Spurr then introduced Julius Loeb, president of the American Metal Co. Mr. Loeb stated that he thought it was a remarkable testimonial to the standing and high respect in which *Engineering and Mining Journal* and its quotations are held by those transacting business on the basis of these quotations that they have been unquestioningly adopted, at least for zinc, for the last ten years or more.

Kelly Describes Work of Real "Divining Rod"

Sherwin F. Kelly, the next speaker, spoke of his recent work with the invention of Professor Schlumberger, of the Ecole des Mines, and told of the results obtained in experiments in various mining districts ranging from Ducktown, Tenn., to Timmins, Ontario. He stated that this method of electrical prospecting is simply a guide in the orienting of a diamond-drill campaign, or the continuing of the development of a partly developed area or country.

S. H. Dolbear, the next speaker, said that he had always had a great admiration for editors, and could talk about them in general without singling them out. This he attributed to the fact that in his youth he became reckless and became a publisher of a country newspaper, near San Francisco, in a small mining camp. According to his story he continued there about six months, and during that time he made more enemies and lost more money than in any period before or since.

Geology Applied to Dining

Mr. Spurr then introduced A. H. Hubbell, news editor of the *Journal*, and also editor of the "By the Way" column. Mr. Hubbell spoke of the co-operation which he received in securing news from the various points in the mining field, and also referred to the practice which some of the *Journal* readers have of taking seriously the "By the Way" page. In closing, Mr. Hubbell made reference to Mr. Spurr's book "Geology Applied to Mining" and added that the entertainment of the evening furnished an excellent example of what "Geology can do when it is applied to dining."

J. H. Lang, president of the American Metal Exchange, said that he did not feel obliged to give much of a speech, inasmuch as he had been asked to talk on the subject of tin mining in America, and there was no such thing. Continuing seriously, Mr. Lang added, "We have got a perfectly good metal exchange in New York, and if we were to work and really do our business on our own exchange, we would have the greatest metal exchange in the world and be a great benefit to the metal trade and the commercial and financial interests of the entire country."

In introducing the next speaker, Mr. Spurr stated that he almost said that he was going to ask him to speak on "one of the burning questions of the day." He referred to F. G. Clapp. Mr. Clapp stated that he had been very much pleased with the Petroleum Section of *Engineering and Mining Journal.*

War Finance Corporation Reviving Business

H. G. Moulton, former assistant to the chief of the War Finance Corporation, was the next called upon. Mr. Moulton outlined something of the past and present work of the War Finance Corporation, which just now is engaged principally in trying to revive business, which ultimately, he stated, means a revival of business in the mining industries.

F. F. Colcord, upon being called by the toastmaster, decided to speak on "nothing else" instead of "anything else." Mr. Colcord stated that he was in the position of the railroad man who was accosted by the new president of the road. After telling the president that he had been working for the company for twenty-five years, the president asked him what was his job. The man replied that he did not know, and Mr. Colcord related this incident to illustrate the fact that he did not know what he would speak about.

Contact as Applied to Editors

Mr. Spurr next introduced Kirby Thomas as a "well-known optimist, who is certainly not a bear on the United States." Mr. Thomas said that if mining was accepted as a game of chance and put into the same class with gambling, preaching and getting married, he supposed that the *Journal* might be classed with the *Police Gazette* or Izaak Walton's paper or perhaps with the *Matrimonial News.*

Paul Wooton, Washington correspondent of *Engineering and Mining Journal*, was introduced by Mr. Spurr as "*persona grata* in Washington." Mr. Wooton dates his connection with the *Journal* from May, 1906, when he was running a weekly paper in southern Mexico, and was installed as correspondent for that section of the *Mining World*, which was afterward taken over by *Engineering and Mining Journal.* Charles Hardy, the next speaker, in speaking of the marketing of foreign ores, stated that apparently nobody realizes how few people buy foreign ores. Mr. Hardy said: "If you take tungsten ore, you have eighteen buyers; of manganese six; of copper ore, probably four at the most; yet though there are so few buyers you cannot bring the four or six of them to adopt a standard contract."

Importance of Near East Mining

Mr. Spurr, in introducing the next speaker, made reference to his own residency in Constantinople, when he was in service of the Sultan of Turkey as consulting mining engineer. He then introduced Djevad Eyoub, who sketched briefly mining conditions in the Near East, and called particular attention to the petroleum deposits of Mesopotamia, which he predicted would some day be one of the most important fields in the world. He hoped that the United States would prevail upon Great Britain to have some interest in that section. E. L.

Gruver spoke on the subject of mining engineers' reports. These he defined as "some optimistic, some pessimistic, and most of them non-committal."

METALLURGY IN THE "JOURNAL"

E. H. Robie referred to the articles on metallurgy which have appeared in *Engineering and Mining Journal*. He said that for every hundred men that are interested in mining there are possibly half of those who are interested in milling, five or six in smelting, and one or two in refining, so that it was hardly to be expected that the *Journal* should devote quite as much attention to the metallurgical side of things as other activities treated in the paper.

Dr. H. M. Payne said that he had always found the *Journal* one of the greatest aids that he has in his work. He also called attention to the human side of the publication, and said that this attribute had given mining men a general feeling that mining, after all, is a pretty good thing with which to be connected.

S. Sussman, in speaking of the London metal exchange, stated that "it acts as a sort of a clearing house for the metal industries of all the world." London is, after all, the oldest metal market, said Mr. Sussman.

S. H. Ball was asked to speak on the subject of diamonds in the Belgian Congo. He replied that he had a very interesting lecture which did not take more than four hours to deliver, so he begged to be excused on account of the lateness of the hour.

COPPER MINES TO RESUME SOON?

M. H. Crego, of the Phelps Dodge Corporation, said that he expected that inside of three months most of the copper mines are going to start something. He stated that the employment situation would probably be a serious question, because many of the men who have lost their employment in copper camps have left for other districts.

Oliver Bowles, of the U. S. Bureau of Mines, told of the work in non-metallics which is being done by the Bureau. He stated that he was interested in knowing from the summary of subjects covered by the *Journal* of last year that the literature published on non-metallics would make a book of 350 pages. Mr. Bowles hoped that this would increase in volume and that the contributors would keep in mind the tremendous importance of the non-metallics in the economic life of the country.

E. H. Behr spoke with relation to the establishment of a metal exchange in New York. He said that it would be the logical outcome of present conditions, inasmuch as this country is the biggest consumer and the biggest producer of non-ferrous metals.

W. Spencer Hutchinson recalled his first connection with *Engineering and Mining Journal*, about twenty-five years ago, when Professor Richards had recommended him to Mr. Rothwell, who had invited him to come to New York and join the *Journal's* staff, but he decided to stick to mining.

THE VALUE OF "JOURNAL" MARKET QUOTATIONS

H. M. Brush stated that *Engineering and Mining Journal* was taking a real responsibility on its shoulders in giving out to the world quotations which form the basis of millions of dollars' worth of contracts. There is no hesitancy on the part of any of the companies to offer either to buy or to sell on *Journal* quotations, and he felt sure that the editors would continue to give this matter the most careful, conscientious and exact attention which they have done in the past.

F. E. Wormser related briefly some of the experiences encountered in the preparation of the market quotations. He expressed appreciation for the co-operation which had been received from the producers and consumers in New York and elsewhere.

E. C. Holden, in replying to the toast "The Old-Time Mining Engineer," said that the old-time mining engineer very much resembled the miner of today. "He had a Lizzie, for instance. Of course it had long ears, but it has a brain very much like the one we have today. The old-time mining engineer was an irreproachable thing. You would not dare approach him, because he was a good shot both with his revolver and his tobacco juice."

V. C. Leftwich was assigned the subject "How Can the *Journal* Be Improved?" but he stated that inasmuch as his subject was limited to a three-minute discussion he did not know whether it was too long or too short a time.

DR. KUNZ DISCUSSES DIAMONDS

Dr. G. F. Kunz pointed out the simplicity of the metric system as against our modern system of weights and measures, comparing the latter to the Tower of Babel. Briefly summing up the diamond situation, Dr. Kunz remarked that it is not that diamonds are not selling, but the fact that the diamond producers are much worried because many diamonds are getting on the market and that interferes with the production. He said that it would be just as if every old pot and kettle made of copper or brass in the United States were melted up and came into the market, and he regards the situation as a serious one.

H. J. Wolf, in speaking on "Our Duty to the Mining Industries." said that he had come to the conclusion that oftentimes the best articles were in the fewest words and were almost always those that were systematically arranged and showed that the man had thought over his subject systematically. He closed by telling the Mark Twain story concerning the preacher who talked so long that one of his parishioners, who was charitably inclined at the beginning of the sermon, and had decided to place a large donation in the collection plate, ended up by removing 10c. when the plate was finally passed.

STANDARD ORE CONTRACTS ADVOCATED

Dr. A. R. Ledoux spoke briefly on the suggestion made earlier in the evening by Mr. Hardy, relative to the procuring of standard contracts for the sale of ores and metals in the American market. He stated that there was a great discrepancy between contracts, and if a more general form of contract could be adopted for copper, silver, gold, and the other metals the accomplishment would surely be worth while. Dr. Ledoux also proposed a vote of thanks to the host of the evening and his associates on *Engineering and Mining Journal*, for the instructive evening and the dinner.

Mr. Spurr in closing said: "I wish to express my thanks to you. All my joy and anticipations with which I looked forward to this meeting have been fully justified. I wish to thank you for your co-operation in the past. I want to work with you in the future. I thank you for your praise; I thank you for your adverse criticism, and I want to make 1922 a better year than we did 1921."

Mr. Fitch's Story of the Breaking of the Record

Efficiency Plus Marked Every Phase of Operations in Completing the Work—Handling of Materials and Arrangement of Shifts Essential Features of Achievement

THE FOLLOWING ACCOUNT of the methods used and other data relating to the sinking of the Water Lily shaft at Eureka, Utah, has been courteously supplied to us by Walter Fitch, Jr.:

In 1916 we made 261 ft. in thirty-one days in the Homansville shaft. At that time we announced a World's Record, and as no one contested it we assumed our claim was correct. This accomplishment, however, aroused new interest, and in a few years our record was exceeded several times. On May 15, 1920, *Engineering and Mining Journal* made this contest official and offered a gold medal for the World's Shaft-Sinking Record, appointing a committee to award the prize and specify rules and regulations.

Upon being awarded the contract for the Water Lily shaft in July, 1921, we were quite convinced that the conditions there were favorable for record speed. We therefore set about to make our plans accordingly. The management of the Chief Consolidated Mining Co. gave us all necessary support and encouragement, and so equipped the property as to make the utmost speed possible.

We estimated an advance of 350 ft. or more in a thirty-one-day period would be possible by shortening the cycle of operations, including drilling, mucking, and timbering, which are ordinarily distributed over twenty-four hours, into eight hours, making three complete cycles in a day. Better results can be obtained by three short rounds each day than one or two long ones. Short rounds break and drill better, save explosives, and are more quickly ventilated.

The shaft is vertical and was bottomed at 115 ft. at the beginning of operations. Two compressors supplied air, averaging from 100- to 115-lb. pressure. Hoisting was done through two compartments by separate hoists electrically driven. The crossheads were eliminated the first few hundred feet to avoid accidents and facilitate the work. We lined each of the hoisting compartments with two vertical lagging on the inside, equally spaced to prevent the buckets from catching the timbers. Non-rotating hoisting cable is absolutely essential when operating in this manner.

The buckets were dumped by an automatic discharger. Through this ingenious device, developed by H. L. Connelly, master mechanic of the Chief Consolidated Mining Co., the hoisting of muck was greatly accelerated. The timbers used were 8 in. x 8 in., sets being spaced at 5-ft. intervals. Outside shaft dimensions are 15 ft. 6 in. x 5 ft. 9 in. divided into three compartments of 4 ft. 4 in. x 4 ft. 6 in. each. The entire shaft was lined on the outside by 2 in. x 12 in. lagging. The manway was carried in the third compartment with a staggered ladderway. In this compartment was also carried the ventilation pipe and air line.

A set of steel I-beams to protect the set timbers in the bottom against the blasting of the rock was suspended by two chain blocks below the last set. By lowering it sufficiently to install a set of timber it also served as a platform on which the timbermen might work without interfering with the operations of drilling and mucking in the bottom. This method is indispensable for speed and affords additional protection for the men.

We wished to follow our accustomed plan of bonusing the men, but with the monthly footage we had in mind no ordinary base could be used, and it was feared any reasonable award would seem beyond their reach. The additional speed we had planned was not to be obtained through increased efforts on their part alone, but a proportion was to be gained through the methods and supervision applied. We finally decided upon the following table of rates and bonus, and, establishing our pace almost immediately, the men soon saw the possibilities and applied themselves with great enthusiasm.

WATER LILY SHAFT WAGE RATES

Shaftmen	$5.25
Hoistmen	5.00
Topmen	3.75

BONUS

Footage Made in Thirty-one Day Period	Shaftmen, Timbermen and Shift Bosses Working Full Month, per Month Each	Hoistmen and Topmen Working Full Month, per Month Each
212	$15	...
262	30	$15
287	45	...
312	60	30
337	75	...
362	90	45
387	105	...
412	120	60
437	135	...
462	150	75

With creditable pride the men were anxious to establish a record and also to receive the award of a silver medal offered by *Engineering and Mining Journal*. As the shaft was situated six miles from Eureka, it was deemed advisable to take the men to and from work by motor truck, rather than camp them on the job. Small temporary camps are unpopular and make it difficult to retain some desirable workers. The monthly labor turnover speaks for itself, considering the fact that there were only four changes made during this period. The crew itself made short work of any slackers. Men usually work more efficiently for a contractor, because as a rule they can earn more money and make a better showing through the individual attention they receive.

The machines used consisted of seven Denver Rock Drill Manufacturing Co.'s "Waugh Clipper-55," one Ingersoll-Rand "DCR-14," and one Sullivan "DP-33 air tube rotator." An average of five machines were operated each shift. Seven-eighths-inch hexagon hollow drill steel with the double taper bit was adopted for the work.

All but 60 ft. of the record run passed through a porphyry formation of average hardness, and the remainder was limestone. Almost the same rate of speed was maintained in both formations. In another thirty-one-day period an advance of 416 ft. was made through hard limestone. Hercules Gelatine LF powder of 35 per cent was sufficient in the porphyry, but considerable 50 per cent was necessary in the limestone. The powder was detonated by Dreadnaught fuse and No. 8 Hercules blasting caps. No water was encountered.

A blower conveyed fresh air through an 8 in. galvanized pipe to the bottom of the shaft.

J. D. Matheson, general foreman, and Henry Jarvis, shaft foreman, are entitled to great credit for the methods employed and the skillful supervision applied.

The following table of averages, I think, will supply all the remaining details of interest:

World's shaft sinking record	427½ ft. in thirty-one days
Size of buckets	17 cu.ft.
Power per ft.	15.25 lb.
Average footage per day	13.80 ft.
	Number
Buckets hoisted per shift	72.5
Sets timber installed per day	2.8
Timbermen per day	4.8
Shaftmen per shift	5.7
Holes drilled per round	23.9
Rounds per day	3.0
Hours delay in thirty-one day period on account of repairs and power failures	13.0

The following men, members of the sinking crew at the Water Lily Shaft, will receive the silver medals:

J. D. Matheson, general foreman; H. W. Jarvis, shaft foreman; R. C. Farrell, Henry Johnson and John Osborn, shift bosses; P. C. Carman, head timberman; M. Anderson, Ben Benson, Mark Borcik, B. Broadbent, George Close, W. H. Currie, R. T. Davis, William Erickson, A. J. Foley, G. Green, M. Jones, Paul Kish, Eugene Lambson, Tony Laris, Joe Miller, Martin Neilson, R. D. Runnells, John Severson, W. V. Spencer, and A. F. Woodruff, shaftmen; George Atcheson, William Hoskins, Lee Hayward, W. Okeson, and A. Webb, shaft and timber men; E. W. Carter, Tom Householder, E. H. Osborn, Julian Peterson, A. Richmond, and J. Savage, hoistmen; Art Brown, D. Chandler, R. E. Ferguson, A. R. Nelson, M. D. Richmond, and H. Van Wagner, topmen.

CONSULTATION

Centrifugal vs. Reciprocating Pumps

"We have tried to secure reliable data regarding pumping equipment for mines, particularly as to the best type of pumps to use. The pump specialists seem to be divided into two camps—viz., those favoring the centrifugal type of pump and those preferring the plunger type. Can you give me any further light on the subject?

"Our power is electricity, and no steam is available. For sinking we use centrifugal pumps. For station pumps we now use three-stage centrifugal pumps, which have not proved satisfactory. Probably a better-designed centrifugal pump station would have given entire satisfaction. We propose ordering two ——— triplex pumps of the plunger type, each with a capacity of 500 gal. per minute at 230 ft. head. We should like to get data regarding the type of station pump generally installed now by experienced managers. If you know of any publication, book, or pamphlet recently published, and which contains the information sought, we shall consider it a favor if you will tell us of it."

Both reciprocating and centrifugal pumps have advantages and disadvantages that give each type its particular field. Thus, for pumping a large volume of water under a low head, the centrifugal pump is excellently adapted, but for pumping under unusually high heads or greatly varying heads the reciprocating pump is more efficient. Between these extremes lies a zone covered by both types of pumps.

In general, the reciprocating pump is positive in action, rugged in construction, operates efficiently under many heads, and can often be run by more than one motive power. On the other hand, the centrifugal pump is simpler than the reciprocating type, has fewer moving parts, requires less attention, and is more compact, and hence requires less space than a plunger pump of the same capacity. However, it works best at a specified head, operation above and below which entails a sacrifice in efficiency. In general, the limit of single-stage centrifugal pumping is 75 to 200 ft. Multi-stage centrifugal pumps are in use to overcome the limitation of single-stage operation.

The centrifugal pump can be suddenly overloaded without damage to its mechanism, whereas an overload of a reciprocating pump through an obstruction or otherwise may seriously injure the machine. The ratio of efficiency between plunger and centrifugal pumps is about 4:3. The advantages of the centrifugal pump make its use particularly desirable in a mine where pumping is generally done under a fixed head. However, an investigation conducted by *Engineering and Mining Journal* for the purpose of ascertaining to what extent each type of pump is used in the mines, smelters, and mills of Canada and Mexico, as well as in those of the United States, indicates that the reciprocating type is the more generally favored.

A detailed tabulation of pumping installations in North America from companies willing to supply this information as follows. The data are not always complete and the survey is not comprehensive enough to give more than a general idea of pumping practice. We know of no publication giving this information.

MINE PUMP INSTALLATIONS IN NORTH AMERICA

LEGEND

S, Steam; A, Air; E, Electric
Cent., Centrifugal; Simp., Simplex; Dup., Duplex; Tri., Triplex
Ex., Expansion; Quin., Quintuplex; Com., Compound; Recip., Reciprocating

Metal Mined and State	Number of Mines Using	Number of Pumps	Drive	Type	Capacity, Gal. per Min.	Head Feet	Service
Copper	1	2	S.	Tri. Ex. Dup.	1,400	450	Drainage
Arizona		1	S.	Tri. Ex. Dup.	900	650	Drainage
Company No. 1		1	S.	Tri. Ex. Dup.	900	850	Drainage
		4	S.	Tri. Ex.	1,200	650–950	Drainage
		1	E.	Triplex	600	200	Drainage
		2	E.	Triplex Plunger	400	400	Drainage
		2	E.	Triplex Plunger	200	400	Drainage
		1	E.	Quin. Plunger	1,000	650	Drainage
		2	E.	Quin. Plunger	1,200	600	Drainage
		2	E.	Cent.	1,600	650	Drainage
		2	E.	Cent.	1,000	450	Drainage
Company No. 2	1	1	E.	Quin.	300	1,500	Drainage
		3	A.	Sinkers	200–600–350	200	Drainage
Company No. 3	4	6	E.	Vert. Tri.	100–175	290–470	Drainage
Gold	2	2	E.	Tri.	200	1,783	Drainage
California		2	E.	Tri.	100	650	Drainage
		3	A.	Simp.	38–58	500	Sinking
Lead	1	1	E.	Cent.	1,800	840	.....
Colorado		4	E.	Cent.	1,500	450	.....
Phosphate	8	6	S.	Tri. Ex. Dup.	2,000	280	Hydraulic.
Florida		5	S.	Tri. Ex. Dup.	2,600	280	Hydraulic.
Company No. 1		1	S.	Cr. Com. Dup.	5,600	300	Hydraulic.
		2	S.	Cr. Com. Dup.	4,800	300	Hydraulic.
		3	E.	Cent.	3,500	400	Hydraulic.
Company No. 2	1	1	E.	3-stage Cent.	3,700	365	Hydraulic.
		1	E.	4-stage Cent.	4,000	400	Hydraulic.
		10	E.	1-stage Cent.	10	100	Hydraulic.
		14	E.	1-stage Cent.	12	100	Hydraulic.
Lead	3	1	E.	Tri.	176	1,000	Drainage
Idaho		1	E.	Tri.	200	450	Drainage
Company No. 1		1	E.	Tri.	200	200	Drainage
		3	A.	Plunger	200	200, 400 and 600	Drainage
			A.	Plunger	500	200	Drainage
Company No. 2	1	1	E.	Cent.	50	200	Drainage
Lead-Silver	1	1	E.	Cent.	50	200	Drainage
Idaho							
Gold	1	2	A.	Simp.	...	600	Drainage
Idaho							
Lead and Fluorspar	2	3	S.	Recip.	300–1,000	200–520	Sta. pumps
Illinois		1	E.	Plunger	500	200	Sta. pumps
Company No. 1		3	S.	2 Simp. and 1 Comp.	500	400–500	Sta. pumps
		1	S.	Simp.	250	300	Sta. pump
		1	S.	Simp.	150	200	Sinking pump
Company No. 2	3	5	S.	Comp.	300–1,200	300–500	Drainage
		1	S.	Comp. Dup.	500	200	Drainage
		2	S.	Dup.	300–400	100–300	Drainage
		1	S.	Dup.	1,000	300	Drainage
		1	S.	3-stage Cent.	1,300	500	Drainage
Copper	2	4	E.	Plunger	300	1,000	Drainage
Montana		4	A.	Dup.	150	200	Drainage
Company No. 1		2	A.	Simp.	150	200–400	Sinker
		2	E.	Dup.	150	600	Drainage
Company No. 2	1	3	S.	Com. Dup.	570	300–400	Drainage
		1	S.	Dup.	650	300	Drainage
		1	S.	Com. Dup.	1,000	800	Drainage
		1	A.	Dup.	100	60	Drainage
		1	E.	Quin.	500	600	Drainage
		1	E.	Quin.	825	1,200	Drainage
		2	E.	Cent.	500	25	Drainage
		1	E.	Cent.	300	25	Drainage
Company No. 3	30	23	E.	Quint.	600	1,000	Acid Mine water
		1	E.	Tri.	350	600	Acid Mine Water
		1	E.	Quint.	250	900	Acid Mine Water
		7	S.	Dup.	600	200	Sinker
		2	S.	Dup.	250	200	Sinker
Company No. 4	2	1	E.	Plunger	300	1,016	Drainage
		1	A.	Dup.	300	1,016	Drainage
		1	E.	Plunger	300	989	Drainage
		1	A.	Dup.	300	989	Drainage
		2	E.	Dup.	150	400–600	Sinkers
		2	A.	Dup	150	200	Sinkers
		1	E.	Tri.	300	504	Drainage
		1	E.	Tri.	100	200	Drainage
		2	A.	Plunger	100	100–200	Sinkers

Metal Mined and State	Number of Mines Using	Number of Pumps	Drive	Type	Capacity, Gal. per Min.	Head Feet	Service
Copper	2	2	S.	Comp	1,800	1,200	Drainage
Nevada							
Gold	1	1	E.	Tri.	100	200	Drainage
Nevada		2	E.	Tri.	400	200	Sinkers
Company No.1							
Company No.2	1	2	E.	Sinker	400	200	Sinkers
Silver-	1	1	S.	Dup.	350	465	Drainage
Manganese		1	S.	Dup.	200	125	Drainage
Nevada		1	S.	Dup.	650	250	Drainage
		1	A.	Sinker	250	150	Drainage
Silver-Gold	3	2	E.	Cent.	350–500	200	Drainage
Nevada		1	E.	Cent.	500	1,600	Drainage
		2	E.	Plunger	110–140	1,500	Drainage
		1	E.	Plunger	340	1,600	Drainage
		1	E.	Plunger	150	1,200	Drainage
		3	A.	Plunger	150–300	....	Sinkers
		2	E.	Cent.	300	....	Sinkers
Iron	6	4	E.	Cent.	900	1,300	Drainage
Michigan		4	E.	Cent.	900	300	Drainage
Company No.1		..	E.	Tri.	100–400	....	Drainage
Company No.2	1	4	S.	Plunger	50–500	30–800	Drainage
		1	S.	Cent.	500	800	Drainage
		2	S.	Plunger	500–700	300–500	Drainage
Company No.3	3	2	E.	Plunger	400–600	120–500	Drainage
		1	E.	Tri.	50	350	Drainage
		1	E.	Cent.	100	40	Drainage
		1	S..	Tri.	100	50	Drainage
Iron	1	1	E.	Tri.	350	250	Drainage
Minnesota		1	S.	Com.	350	250	Drainage
Company No.1		1	S.	Simp.	200	250	Drainage
Company No.2	3	2	E.	Dup.	1,000–1,600	300	Drainage
		4	E.	Cent.	1,000–1,200	300	Drainage
		2	E.	Tri. Dup.	150	300	Drainage
		1	E.	Cent.	50	50	Drainage
Company No.3	6	6	E.	Tri.	350-2,000	100-235	Drainage
		1	E.	Tri.	100	200	Drainage
		4	E.	Cent.	365-2,000	100–235	Drainage
		2	E	Cent.	300	50	Drainage
		2	E.	Dup.	....	....	.....
Company No.4	3	1	S.	Tri. Ex. Dup.	875	1,000	Drainage
		1	S.	Com. Dup.	875	1,000	Drainage
		1	S.	Com. Dup.	900	500	Drainage
		1	S.	Com. Dup.	400	1,000	Drainage
		1	S.	Tri. Ex. Dup.	500	1,000	Drainage
		1	E.	Tri. Ex. Dup.	250	200	Drainage
		1	E.	Tri. Ex. Dup.	200	1,200	Drainage
		1	E.	Cent.	100	300	Drainage
		1	E.	Cent.	1,000	300	Drainage
Company No.5	5	1	E.	Recip.	150	118	Drainage
		1	E.	Tri.	150	175	Drainage
		1	E.	Tri.	60	204	Drainage
		3	S.	Simp.	150 200 800	204 175 220	Drainage
		1	E.	Tri.	500	220	Drainage
		1	E.	Cent.	150	250	Drainage
		1	E.	Tri.	75	220	Drainage
		1	S.	Simp.	25	220	Drainage
		1	E.	Recip.	250	220	Drainage
		1	E.	Dup.	1,350	220	Drainage
Company No.6	6	2	E.	Tri.	800–2,000	235	Drainage
		1	E.	2-stage Cent.	2,000	235	Drainage
		1	E.	Tri.	500	145	Drainage
		1	E.	Cent.	300	50	Drainage
		1	E.	Tri.	500	130	Drainage
		2	E.	Cent.	365	130–165	Drainage
		2	E.	Tri.	350	100–200	Drainage
		1	E.	Dup.	100	130	Drainage
		1	E.	Dup.	40	40	Drainage
		1	E.	Tri.	100	200	Drainage
		1	E.	Cent.	600	100	Drainage
		1	E.	Cent.	75	40	Drainage
Zinc	1	1	E.	Recip.	65	285	Drainage
Missouri							
Company No.1							
Company No.2	2	3	S.	Dup.	....	175	Drainage
		2	E.	2-stage Cent.	500	200	Drainage
Company No.3	2	3	E.	Cent.	4,000	230	Drainage
		4	E.	Deep Well	2,000	230	Drainage
Company No.4	3	1	S. or A.	Recip.	250	190	Drainage
		2	S. or A.	Recip.	190	310	Drainage
		4	E	Cent.	750	310	Drainage
		1	E.	Deep Well	750	210	Drainage
		1	S.	Lift	400	160	Drainage
		1	S.	Recip.	350	160	Drainage
Gold-Silver	1	1	E.	Tri.	100	500	Drainage
New Mexico							
Pyrites	1	2	E.	Cent.	150	100	Drainage
New York							
Iron	2	2	E.	Cent.	300	800	Drainage
New York		2	E.	Cent	250	70	Drainage
		9	E.	Cent.	300	325–375	Drainage
		2	A.	Plunger	200	300	Drainage
Lead	1	1	E.	Cent.	200	200	Drainage
Oklahoma		1	E.	Tri.	250	250	Drainage
		4	S.	Simp.	300–500	225	Drainage
Gold	1	2	E.	2-stage Cent.	500	196	Drainage
South Dakota		1	E.	3-stage Cent.	500	310	Drainage
		8	E.	3-stage Cent.	1,000	315	Drainage
Copper	2	19	A.	Simp.	....	200	Acid Water Drainage
Tennessee		3	E.	Plunger Tri.	....	400	Acid Water Drainage
Phosphate	1	1	E.	Sand	750	17	Sand and Dredging
Tennessee		1	S.	Sand	750	17	Sand and Dredging
		1	S.	Sand	750	40	Sand and Dredging
Zinc	2	2	E.	Dup.	650	400	Drainage
Tennessee		1	E.	Tri.	650	550	Drainage
		4	E.	Cent.	1,000	400	Drainage
		3	E.	Cent.	1,000	550	Drainage
		1	E.	Cent.	900	400	Drainage
		1	S.	Dup.	650	550	Drainage
		1	E.	Tri.	300	250	Drainage
		1	S.	Dup.	300	250-90	Drainage
		1	S.	Recip.	....	90	Drainage
		2	S.	Simp.	300	30	Drainage
		1	E.	Simp.	250	30	Sinker
		2	S.	Simp.	350	100	Drainage
		1	E.	Cent.	1,200	200	Drainage
Silver	1	2	E.	Cent.	750	140	Drainage
Utah							
Lead-Copper	1	1	E.	Plunger	400	800	Drainage
Utah							
		1	E.	Plunger	250	800	Drainage
		1	A.	Sinking P.	....	130	Sinker
Silver	1	1	S.	Plunger	1,500	214–100	Drainage
Utah		1	E.	Cent.	1,600	214	Drainage
		1	E.	Cent.	1,500	250	Drainage
		1	E.	Cent.	1,100	250	Drainage
		2	E.	Cent.	300	100	Drainage
		1	E.	Cent.	500	125	Drainage
		1	E.	Cent.	125	100	Drainage
		1	E.	Cent.	182	100	Drainage
Copper	2	1	A.	Simp.	....	175	Drainage
Utah		1	A.	Simp.	....	175	Drainage
		1	A.	Simp.	100	120	Drainage
		1	A.	Simp.	60	100	Drainage
		1	A.	Simp.	35	175	Drainage
		1	A.	Simp.	60	125	Sinker
		1	E.	Cent.	40	....	Drainage
		1	E.	Tri.	12	....	Drainage
Open-Pit Iron Mine	2	1	S.	Dup.	....	60	Out of Service
Virginia		1	S.	Dup.	....	100	Drainage
Zinc	3	4	E.	Cornish	75–150–200	148	Drainage
Wisconsin					and 350	174	Drainage
		1	E.	Cent.	200	172	Drainage
		1	E.	Cent.	650	174	Drainage
		1	E.	Cent.	400	151	Drainage
Zinc	2	2	E.	Tri.	100	1,336	Drainage
Eastern United States		2	E.	Cent.	350	525	Drainage
		2	E.	Cent.	275	225	Drainage
		3	E.	Cent.	450	977	Drainage
		2	E.	Cent.	200	166	Drainage
		1	E.	Cent.	925	166	Drainage
Gold-Silver	5	2	E.	Cent.	600	150	Sinkers
Mexico		2	E.	Cent.	500	650	Drainage
Company No.1		2	E.	Tri.	300	500	Drainage
		1	E.	Cent.	500	600	Drainage
		6	E.	Tri.	150 300	600 600	Drainage Drainage
		2	E.	Cent.	250	600	Drainage
		1	E.	Cent.	100	100	Sinkers
Company No.2	6	6	E.	Tri.	100–200	400–600	Drainage
		1	A.	Dup.	60	300	Sinker
		1	A.	Dup.	70	700	Sinker
		1	A.	Dup.	100	300	Sinker
Company No.3	2	3	E.	Tri.	75–125	300–650	Drainage
Company No.4	1	2	E.	Cent. 2-stage	1,000	400	Unwatering
Zinc-Pyrites	1	3	E.	Tri.	200–300	200–225	Acid Mine Water
Canada		2	S.	Plunger	100–200	150–172	Acid Mine Water
Gold-silver	1	1	S.	.....	250	200	Drainage
Ontario		1	S.	.....	300	300	Drainage
		1	E.	Tri.	260	200	Drainage
		1	E.	Tri.	200	300	Drainage
		3	A.	Dup.	40–60–100	200	Drainage

It will be noted that the reciprocating pumps greatly outnumber the centrifugals, a circumstance that may be due partly to the older age of the reciprocating pump and its slow displacement by the centrifugal pump (if displacement is going on). Centrifugal pumps, however, seen to be fairly well intrenched in mill work. As a similar investigation too long to reproduce here discloses, of 430 pumps used in various mills of this continent 326 were centrifugal and 104 reciprocating.

Our correspondent fails to state the cause of the failure of the centrifugal pump, which may possibly have been due to excessive grit in the mine water.

HANDY KNOWLEDGE

Neighborly Chats With the Foreman

Powder Densities

BY DUNCAN MACGREGOR

Written for *Engineering and Mining Journal*

Another complaint, Jim, and this time about your powder costs. You said that your men always used the same number of sticks to a hole in spite of all that you have been telling them about cutting down on the powder to suit the ground. That's a natural thing for them to do and they have been doing it for a long time. Habit is hard to break and men forget what you tell them. I think that it's a good plan to let them go on doing it for a while.

A stick of powder is a stick of powder but the weight of a stick depends on the grade of the explosive. Get busy with your superintendent and get him to talk things over with the powder salesman. I read something on this recently in the *Engineering and Mining Journal*.[1] Some of the powder companies are making powder that will run 100, 135 and 150 1¼ x 8-in. sticks to the 50-lb. box, depending on the grade. Get the superintendent to order some of these bulky powders and serve them out to the men for the easy ground. They will use the same number of sticks to a hole but they will weigh less to the charge. You can save a nice amount on this alone. Serve out your powder by counting the sticks. As your men are thinking in number of sticks and not weight of powder, just do the same yourself. Post the mine records in sticks of powder used. Get your men into the habit of tamping their holes thoroughly and see that they have the proper stemming in the proper "cartridges." Then get next to the superintendent and persuade him to work out a powder bonus. Split the savings you make on powder with the men and get them interested in greater economy. A little extra coin jingling in the pocket on payday will make every man as wise as a Scotchman when it comes to using powder. In time you will get them to judge the ground for themselves and then it will be plain sailing for the mine.

Shaking Screen and Slime Pump

BY CHARLES LABBE

Written for *Engineering and Mining Journal*

In a laboratory where pulp samples are not regularly handled, inexpensive devices have to be used. Rather large samples have to be screened oftentimes and to avoid hand labor the following may be found of value: A screen 12 x 30 in. in dimensions is hung from the ceiling by three adjustable rods. A shaking motion may be imparted to it by the movable jaw of the sample crusher on which is bolted a slotted piece of ¼ x 1½-in. flat iron, with a ⅜-in. bolt with thumb nut which can be screwed up or down, to vary the length of stroke. As the crusher is needed at the same time as the screen this arrangement is quite simple.

Screens of various meshes may be used, but they are all of the same dimensions, 12 x 30 in. They are held tight in the frame with a tapered wood key on each side, thus providing for quick removal and easy cleaning. The device is shown in Fig. 1.

To draw samples of partly settled slimes, decant or transfer small quantities of slimes. The pump shown in Fig. 2 is made of pipe and fittings and has given satisfaction.

The foot piece is a short nipple having one end split and spread for intake, the other being screwed in a

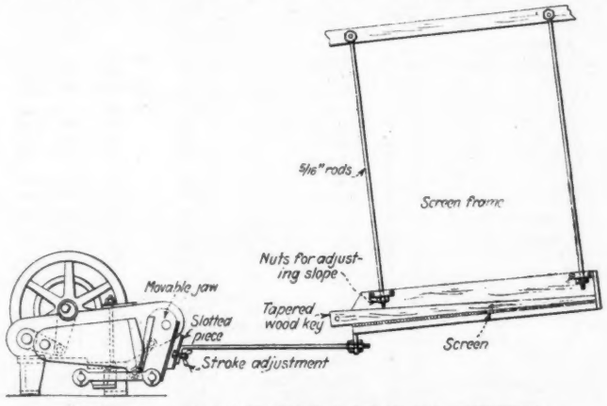


FIG. 1. A LABORATORY SHAKING SCREEN

2-in. coupling. The foot valve, which is located in the coupling, may be made of a 1⅝-in. iron ball which seats itself on an iron washer 2¾ in. in diameter with a 1¼-in. hole. The upward travel of the valve is limited by a ¼-in. bolt 2¾ in. long. This bolt also limits the downward stroke of the plunger.

The plunger is made of 1¼-in. pipe, the lower end of which is threaded for about 2 in. The packing is made of washers cut out of used rubber belting and held on the plunger by a 1¼-in. pipe locknut which has been trimmed off so as to go freely in the 2-in. pipe (the pump cylinder). The packing is held tight by a 1¼-in. pipe cap which screws up against it. A 1⅛-in. hole is bored in the end of the cap and a 1⅛-in. iron ball completes the valve. Six ⅝-in. holes are bored in the plunger for the pulp discharge. For a handle a ½-in. hole is bored in the upper end of the plunger and a ½-in. bolt, 12 in. long, passed through it clamping a piece of ½-in. pipe 5 in. long on each side. The plunger is guided to prevent side-play by a 2 to 1¼-in. bushing screwed in the tee. For the discharge any piece of 2-in. pipe may be used of the length to suit the work.

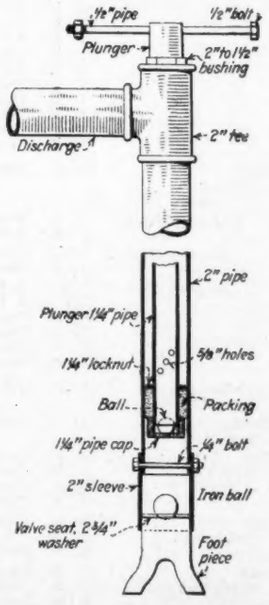


FIG. 2. A SLIME PUMP

[1] *Engineering and Mining Journal*, Nov. 26, 1921, p. 862.

THE PETROLEUM INDUSTRY

Natural-Gas Gasoline in the United States In 1920

The term "natural-gas gasoline," as used by the U. S. Geological Survey, means gasoline recovered by all methods from both "wet" and "dry" natural gas and is synonymous with "casing-head gasoline" and "natural gasoline," terms used in the trade. The Association of Natural Gasoline Manufacturers, soon after its organization, proposed the term "natural gasoline," which is now being generally used, but the Survey considers "natural-gas gasoline" the more appropriate term.

The output of natural-gas gasoline continued to increase in 1920 and exceeded that made in 1919 by 31,776,791 gal., or 9 per cent, as compared with an increase of 24 per cent in 1919, according to the U. S. Geological Survey. The figures for 1920, however, are subject to revision. The average daily production of natural-gas gasoline in 1920 was 1,050,170 gal., as compared with 963,110 gal. in 1919.

Natural-gas gasoline is extracted from natural gas by two distinct methods, the compression method, which includes also refrigeration, and the absorption method. About 73 per cent of the output in 1920 was produced at the compression plants and the remainder at the absorption plants. The compression method is applied to the "wet" gas, which contains more gasoline. The absorption method is used in treating "dry" gas, which contains only a small proportion of gasoline vapors—less than a gallon in a thousand cubic feet of gas. As dry gas cannot be treated successfully by the compression method the absorption method was devised and is being used with good results.

The total quantity of gasoline produced in the United States in 1920 was 5,133,435,658 gal. Of this quantity 4,750,123,841 gal., according to statistics compiled by the Bureau of Mines, was obtained from crude petroleum, and 383,311,817 gal., or 7 per cent of the total, from natural gas. The annual output of natural-gas gasoline averages between 7 and 8 per cent of the total annual gasoline output in the country. This percentage in itself is small, but as natural-gas gasoline has a high volatility, it is blended with refinery products, such as naphtha, and is therefore a means of utilizing these blending materials which otherwise would have less value.

The value of the total output of natural-gas gasoline in 1920, as computed from the prices received at the plants, increased $7,337,355. The value of the gasoline produced by the compression method increased $4,509,541 and that produced by the absorption method increased $2,827,815. The average price was approximately the same in 1920 as in 1919—18c. a gallon for the total output, 17½c. for compression gasoline, and 20½c. for absorption gasoline.

November Petroleum Production

The accompanying figures, compiled from company reports to the U. S. Geological Survey, show the quantity of petroleum transported from producing properties. Oil consumed on the leases is not included. This item and net changes in producers' stocks at the beginning and end of the year are obtained by annual canvass and are included in the final statistics of production as issued by the Survey.

PETROLEUM PRODUCED IN THE UNITED STATES IN OCTOBER, 1921, NOVEMBER, 1921 AND NOVEMBER, 1920

Barrels of 42 U. S. Gallons

State	October, 1921 (a)		November, 1921		November, 1920	
	Total	Daily Average	Total	Daily Average	Total	Daily Average
Oklahoma	9,716,000	313,419	9,445,000	314,833	9,028,000	300,933
California(b)	7,065,000	227,903	8,804,000	293,467	9,340,000	311,333
Central and Northern Texas	4,846,000	156,322	5,760,000	192,000	6,711,000	223,700
Coastal Texas	2,730,000	88,065	2,813,000	93,767	2,762,000	92,067
Kansas	2,825,000	91,129	2,709,000	90,300	3,215,000	107,167
Northern Louisiana	1,817,000	58,612	1,752,000	58,400	2,462,000	82,067
Coastal Louisiana	124,000	4,000	114,000	3,800	153,000	5,100
Wyoming:						
Salt Creek	959,000	30,935	1,049,000	34,967	740,000	24,667
Big Muddy	141,000	4,548	132,000	4,400	159,000	5,300
Rock Creek	110,000	3,548	89,000	2,967	178,000	5,933
Grass Creek	99,000	3,194	94,000	3,133	126,000	4,200
Elk Basin	49,000	1,581	36,000	1,200	70,000	2,333
Other districts	123,800	3,994	104,400	3,480	67,000	2,234
Total Wyoming	1,481,800	47,800	1,504,400	50,147	1,340,000	44,667
Arkansas	(c) 1,300,000	41,936	(c) 1,250,000	41,667	.....	.....
Illinois	890,000	28,710	837,000	27,900	847,000	28,233
Kentucky	716,400	23,110	717,800	23,926	723,000	24,100
West Virginia	628,000	20,258	607,000	20,233	656,000	21,867
Pennsylvania	580,000	18,710	594,000	19,800	603,000	20,100
Central and Eastern Ohio	405,000	13,064	409,000	13,634	437,000	14,567
Northwestern Ohio	166,000	5,355	157,000	5,233	165,000	5,500
Montana	153,000	4,936	143,000	4,766	92,000	3,067
Southwestern Indiana	70,000	2,258	70,000	2,333	59,000	1,967
Northeastern Indiana	22,000	710	16,000	533	22,000	733
New York	77,000	2,484	68,000	2,267	75,000	2,500
Colorado	8,200	265	8,600	287	8,000	266
Tennessee	600	19	1,200	40	1,000	33
Totals	35,621,000	1,149,065	37,780,000	1,259,333	38,699,000	1,289,967

(a) Revised. (b) Average of figures reported by Standard Oil Co. and Independent Oil Producers' Agency. (c) Estimated in part.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Mining and Metallurgical Society Holds Annual Meeting

New President Elected—Papers Discussed—Sir John Cadman Talks on Petroleum—Society Medal Presented to Charles W. Goodale

The Mining and Metallurgical Society of America held its annual meeting at the Harvard Club, New York, on the afternoon and evening of Jan. 10. During the afternoon session, at which J. E. Spurr presided, three papers were presented, one by G. F. Loughlin, of the U. S. Geological Survey, on the national mineral policy; the second by Dr. John E. Teeple, on the "Position of the Domestic Potash Producers," and the third by George J. Young on "Some Phases of Technical Education."

At the evening session Walter R. Ingalls presided. The secretary presented the results of the ballot for officers and the following were declared officers for 1922: A. H. Rogers, president; W. Y. Westervelt, vice-president; B. Britton Gottsberger, secretary; W. R. Ingalls, councilor of the first district; R. A. F. Penrose, councilor of the fifth; Seeley W. Mudd, councilor of the eleventh; Reno H. Sales, councilor of the twelfth.

Mr. Spurr, the retiring president, addressed the society members upon the subject of the society and its relations to the Institute of Mining and Metallurgical Engineers. He emphasized the fact that the field of the Institute con-

A. H. ROGERS
President of Mining and Metallurgical Society

cerned itself with technical subjects, whereas the Society confined itself to the broad questions affecting the industry. The effort of the Institute to absorb the society had failed chiefly because the Society members did not want to have their organization another notch on the gunstock of the Institute, nor did it especially like the idea of a bronze tablet on the walls of the Institute.

Mr. Spurr reviewed the year's work of the society and concluded with the

CHARLES W. GOODALE

statement: "For the future I see in my mind's eye the destiny of the society as a fair and lofty structure which we may rear. We need, as I said, enthusiasm; we need the contribution of work; we need intelligent guidance; and we need money. A society with a limited membership and small dues is naturally very poor, with all the limitations of usefulness which that implies. I doubt whether we should try to remedy this by increasing the dues; but I do believe that the society should secure, from time to time, endowments from those that can afford it; that it may thereby eventually secure a proper and dignified home, and be established upon a basis not to be shaken."

Mr. Rogers, the new president, discussed the work of the past year and stated that the program for the coming year would consist largely of concluding the work already begun. He indicated the desirability of reviving the San Francisco section and starting new units, and also securing an increase in membership. He suggested that the society should take up the subject of capital and labor.

Sir John Cadman, the guest of honor, was introduced, and informed the society that he was greatly impressed with his luck at being able to attend such a phenomenal meeting of the Society, including as it did a retiring president, an incoming one, and a gold medal presentation. He illustrated the significance of the word phenomenal by telling a story the point of which was that "a cow sitting on a thistle and singing like a lark would be phenomenal." With the subsidence of the mirth, Sir John plunged into a discussion of the British and American relations in the petroleum industry. He to a considerable degree convinced his audience that the British government was not in the oil business, did not purpose to discriminate against American capital or Americans in the exploitation of oil deposits, and that the British had respect for the ability and resourcefulness of American oil men and our petroleum engineers. He laid about with all the vigor of a red-blooded, two-fisted man in his earnest endeavor to lay the international petroleum banshee to rest.

At the conclusion of Sir John Cadman's address, Mr. Ingalls introduced Dr. Manning. Dr. Manning eulogized Charles W. Goodale. Professor Kemp followed with more good words for Mr. Goodale. Mr. Spurr presented the society's medal to Mr. Goodale for distinguished service in the promotion of safety in mining. Mr. Goodale in his reply discussed safety operations at Butte.

National Mineral Policy

Smith, Spurr, and Leith Address Council On Foreign Relations at Hotel Astor

Following an excellent dinner quantitatively adjusted so as to interfere least with mental clarity, the Council on Foreign Relations, Inc., on the evening of Jan. 6, listened to a thorough presentation of the subject of "Mineral Resources and Their Distribution as Affecting International Relations." The Hon. David F. Houston presided. The speakers were George Otis Smith, J. E. Spurr, and C. K. Leith, all of whom are pioneers of the subject and have had opportunity for detailed study of it.

In substance Mr. Smith said: "The great war put mineral resources upon the map and made their significance apparent. It is now necessary to pass the gospel along. Franklin K. Lane recognized that mineral resources are one of the foundations of national power. It is essential to appraise our mineral resources not in dollars but in tons, as this is the significant measure of mineral wealth. During the past four decades mineral output has increased many fold. The rapidly increasing rate of consumption is the changing standard by which we must measure our unmined resources. The best quality and most easily mined coal is being rapidly depleted and industries in the East face the certainty of decreasing quality and increasing cost.

"There is overdevelopment of certain parts of our mining industry, partic-

ularly in copper, iron, and zinc, and consequently a need for export markets. This need for export markets should be a background for national policy.

"Our outlook should be broad enough to include the world. American capital must realize its obligations to insure our future by reaching out into foreign countries to participate in the control of mineral resources. Pioneering with capital and engineering brains will be helpful to other nations as well as our own. A nation cannot live unto itself alone."

Mr. Spurr said, in brief: "We mining engineers and geologists have a message to our mining industry to the thinkers of the country outside of the profession and to our Government. Our modern civilization is machine-made, and depends upon metals and other raw products for its continuance. Metal crops do not grow—the mining industries are wasting industries. What an active industrial country does not possess in metallic resources she must acquire in trade. Under existing rapidly increasing rates of consumption, the mineral resources of the world are susceptible of exhaustion.

"What should we have as a policy or policies? Should we not take an inventory of our approximate stock in trade of each mineral or metal and frame up a separate policy based upon our supplies, our consumption, and the needs of the rest of the world? Should not these policies determine our governmental acts touching these mineral supplies?

"I take it for granted that the national welfare rather than the interests of a small group should dictate our governmental policies. It is not so much a question of conservatism that we have to deal with as efficient management of what nature has left with us.

"American interests finding their efforts in this country already circumscribed have reached out and own, control, and mine an ever increasing amount of copper, tin, iron, petroleum, and other materials outside our borders. When it comes to government policy, where are the limits we shall draw? Are not the limits of the entity or domain we wish to protect our commercial rather than our political limits? We shall have no lasting friendship between nations and no world peace while we have commercial struggles between great nations, discriminations, and recriminations. Only one kind of entente or alliance can eventually survive—the commercial alliance."

C. K. Leith said that there was need for a program for the handling of minerals on a national basis. Governments were becoming interested because competition was becoming keen. Mineral deposits were so distributed that for each kind a few definite trade channels were marked out. For some of our mineral products there is an exportable surplus; for others we will never have a sufficient supply. Tariffs may or may not be desirable. By means of an artificial wall, some believe that we can build up a supply of a much needed mineral, but overlook the continuance of that supply when exhaustion of the scanty deposits takes place. An economic and political policy around the great trade channels characterizing the movements of minerals is essential. Freedom of exploration is desirable. It is the right of stronger nations to bring pressure to bear upon weaker nations to develop minerals which the world needs. Exclusive concessions should not be made. With proper enlightenment on the subject there would be less talk of tariffs and embargoes. To get results there should first be recognition of the fundamental facts about distribution, and, second, the getting together on an affirmative program rather than by negative international agreements.

MEN YOU SHOULD KNOW ABOUT

Etienne A. Ritter, of Colorado Springs, is in New York en route to Europe.

E. J. Collins, of Duluth, has recently returned from examination work in the Isle of Pines.

T. A. Gowling, of the E. J. Longyear Co., has returned from a trip through the oil fields of Mexico.

K. C. Browne returned to Creighton Mine, Ontario, this week after a three months' stay in the vicinity of New York.

Frederick Bradshaw, of San Francisco, general manager of the Tonopah Belmont Development Co., is in Tonopah.

R. C. Moore, State Geologist of Kansas, has been in Washington conferring with officials of the U. S. Geological Survey.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., has returned to Tonopah from San Francisco and Virginia City.

William Kent, formerly smelter superintendent of the International Nickel Co.'s works at Copper Cliff, Ont., is in New York.

E. F. Burchard has been granted a year's leave of absence by the U. S. Geological Survey, to undertake private work in oil geology in South America.

Ernest N. Patty, formerly mining engineer for the Washington Geological Survey, is now manager of the Gorrier Zinc Mines, near Northport, Washington.

Julien Raick, mining engineer of Liege, Belgium, after spending fifteen months in the various mining districts of the United States, has returned to Belgium.

H. F. Hilliard, formerly with the Tonopah Belmont Development Co., has been appointed mill superintendent for the Simon Silver Lead Mines Co. near Mina, Nev.

J. M. Hill, V. C. Heikes, C. W. Henderson, and **C. N. Gerry** of the western offices of the U. S. Geological Survey, spent the week of Jan. 9 in the Washington office.

Percival G. Butler, since 1916 assistant superintendent of the Douglas smelter of the Copper Queen Branch of the Phelps Dodge Corporation, has been made superintendent.

Dr. Solon Shedd, head of the department of geology at Washington State College, Pullman, Wash., has returned, after a six months' leave of absence which he spent teaching at Stanford.

Miles S. Milward, formerly manager of the Palmarito Leasing Co., and **Edward R. Haggin** have recently formed a partnership under the name of Milward & Haggin, with addresses at P. O. Box 7, Culiacan, Sinaloa, Mexico, and 627 Grosse Building, Los Angeles, Cal.

Mining and metallurgical engineers visiting New York City last week included: **Lester S. Grant**, Golden, Col.; **Donald C. Barton**, Houston, Tex.; **F. B. Burbridge**, Denver, Col.; **Oliver Bowles**, Washington, D. C.; **Arthur W. Jenks**, Berkeley, Cal.; **J. Taniguchi**, Tokio, Japan; **E. P. Dargin**, Cincinnati, Ohio; **E. C. Holden**, Baltimore, Md.; **J. H. Hill** and **Robert S. Hill**, Rapid City, S. D.

OBITUARY

Donald G. Hoyt, mine supervisor of Kennecott Copper Co., was killed recently in a snowslide near Cordova, Alaska.

William Preston Daniels died on Dec. 23, at Denver. Mr. Daniels was sixty-five years old. For the last twenty-five years he had been president and general manager of the Big Five Mining Co.

A. B. Coates, iron mine operator of Virginia, Minn., died Jan. 10 at his winter home near Orlando, Fla. He was fifty-two years old. Mr. Coates was a pioneer developer of the Mesabi Range and was one of the largest independent iron ore operators in that region.

S. R. Porter died on Dec. 14 in his home at the Leland mine, Oatman, Ariz. Mr. Porter has been active in mining development in Colorado and California, but particularly in the Oatman section. He was sixty-three years old.

John Dern died at the age of seventy-one in Salt Lake City on Jan. 2. Mr. Dern's name is most prominently associated with the Consolidated Mercur Gold Mines Co., of Utah. He had large interests in the Tintic district and was, for a number of years, president and general manager of the Uncle Sam Mining Co., vice-president and general manager of the Lower Mammoth Mining Co., and president of the May Day Mining and Milling Co.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

A strike has been declared at the gold and coal mines in the Transvaal, South Africa, according to a dispatch. The matter of employing native labor more extensively is involved.

The Cash Boy and Tonopah Extension companies have ratified the agreement recently drawn up, to avoid apex litigation.

Wages are dropping in various Utah camps. A 50-cent wage cut has just been announced in several districts.

Miners at Mount Morgan, Queensland, are still on strike. Various proposals made, looking to a resumption, have failed.

War minerals relief claimants are said to be hard to locate, now that the Commission is seeking to get in touch with them in consequence of the liberalization of the relief legislation.

The permanent tariff bill is expected to be reported to the Senate before the end of January, it is expected. Considerable opposition awaits it.

Gold Miners on Rand Vote To Strike

Action Results From Proposal To Widen Use of Colored Labor—Wage Reduction Refused

Miners in the gold and coal mines in the Transvaal, South Africa, voted to strike beginning Jan. 9, thus bringing to a culmination the protracted dispute over the attempt of the companies to reorganize their forces by employing native (black) labor to a greater extent, particularly in the semi-skilled occupations. This must be done, according to the companies, in order to reduce costs so as to permit operation under the decreased price of gold. The strike will include all of the plants of the Victoria Falls & Transvaal Power Co., thus effectively shutting down the gold mines of the Rand. The strike was voted for by the men in spite of a plea by the Premier, General Smuts, to accept a reduction in wages.

Breitungs Sued for Commission in Mining Deal

Edward N. Breitung, Charlotte G. Breitung and Mary Breitung, individually and as members of Breitung & Co., Inc., were sued in the New York Supreme Court recently for $420,000, which Ralph Ingalls, the plaintiff claims as commission for selling some Michigan mining properties for $8,000,000, according to the daily papers.

Ingalls says the Breitungs had an interest in the Michigan property which accrued by virtue of their ownership of the majority stock of the Marquette Iron Company. Ingalls was retained to find a purchaser. He interested A. B. Shepherd, of Pittsburgh in the proposition. Shepherd represented the Jones & Laughlin Steel Co., the Jones & Laughlin Ore Co., and the Interstate Ore Co. The sale was effected through his efforts, Ingalls alleges, but the defendants failed to pay him the agreed commission.

Cash Boy and Tonopah Extension Ratify Agreement

Two Companies Settle Differences Avoiding Costly Apex Litigation

The agreement between the Cash Boy Consolidated Mining Co. and the Tonopah Extension Mining Co., whereby costly apex litigation is avoided was ratified Dec. 30. The property of the Cash Boy has been deeded to the Tonopah Extension in accordance with the terms of the agreement. The Cash Boy receives 100,000 shares of Tonopah Extension stock and $20,000 cash.

Iron Ore Producers at Bilbao Anxious Over Competition

By Reuters Agency

Madrid, Dec. 20—During the week ended Dec. 17, 13,000 tons of iron ore was exported from Bilbao, Spain. Of this quantity 3,200 tons went to Germany and the rest to Great Britain. According to calculations made at the mines stocks at Bilbao total 1,600,000 tons. Anxiety is beginning to be felt owing to the competition of Algerian and Tunis ores.

Wages Dropping in Various Utah Mining Camps

Wage reductions are being made in various Utah camps. At Bingham Canyon, men who are receiving more than $3 a day will be reduced 50c. per day; and there will be a reduction of 40c. for those who receive less than $3. Six mining companies in that camp have announced these reductions which will become effective Jan. 16. The list is: Utah Consolidated, affecting fifty men; Utah Apex, twenty; United States Mining, 350; Bingham Mines, sixty-five; Utah-Boston, forty; Utah Copper, sixty. In the Tintic district, beginning Jan. 16, there will be a general reduction of 50c. a day. The remaining camps of the state are also making reductions.

Mines in Tri-State District Change Hands

Homestake, Blue Ribbon and Muncie Sold To Chicago Interests—Price Between Quarter and Half Million

Confirmation has just been made of the most important sale of mining properties in the Joplin-Miami district in more than a year, one wherein the Homestake, Blue Ribbon and Muncie mines of the Baxter-Picher section of the field were purchased by Chicago parties for a consideration not definitely given but officially stated as being "more than $250,000 and less than $500,000."

The Homestake mine is located just west of Baxter, and includes a small mill and a 40-acre lease. It was owned by Frank Childress, of Galena, Kan., and R. L. Kidner, of Kansas City. The Muncie mine is located about three miles west of the Homestake, has a good concentrator, and has been a consistent producer during the year. It has been owned by Oklahoma parties, headed by S. C. Clover, of Tulsa, Okla. It has been operated most of the year by Childress under a lease. The Blue Ribbon is located on a 20-acre tract east of Picher, in Oklahoma, and was formerly owned by Childress, his brother, G. L. Childress, and R. L. Kidner.

Frank Childress retains a considerable interest in the properties and will be retained as general manager. All the other interests have been taken over by the Chicago parties.

Canada Mints Coins of Nickel

In view of the fact that Canada is the largest producer of nickel, the adoption of a nickel coinage to replace small silver has for many years been advocated. It has now been carried into effect and on Jan. 3 the first Canadian nickel 5-cent pieces were struck off at the mint at Ottawa. The coin is composed of pure nickel and weighs 70 grains, being 835 of an inch in diameter.

Oregon Dredging Co.'s Property Sold

The property of the Oregon Dredging Co. was recently transfered to the Superior Dredging Co. Revenue stamps on the deed indicate the sale price as $146,000. The record of the transfer indicates an escrow agreement between the two companies. The property consists of a gold dredge on Clark creek, a tributary of Burnt River, near Bridgeport, Ore. The Oregon Dredging Co. operated for a number of years under the management of W. T. Tanner. The Superior company recently held a stockholders' meeting at Baker, but no formal statement as to plans was made.

Colorado River Commission To Meet

Herbert Hoover Secretary of Commerce, expects to call a meeting of the Colorado River Commission on Jan. 26. The meeting will be held in Washington. Later it is the intention of the commission to hold hearings in the Southwest. At the Washington meeting a general plan of procedure will be agreed upon and limits placed on the scope of the work to be done.

Baker Mines Co. Cut Last Chance Vein in Adit

For the past year the Baker Mines Co., of Cornucopia, Ore., has been at work driving a long crosscut to open up the deeper extension of its Last Chance vein. This crosscut was started from the Clark adit of the Cornucopia Mines Co., an associated company. The vein was cut 1,200 ft. below the present deepest workings and a pay shoot 3 ft. wide exposed. This confirms the opinion of the engineers and geologists that the gold veins of the Cornucopia district are of the deep-seated type.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

War Minerals Relief Claimants Hard To Find

Many Fail To Answer Notices Advising Them Legislation Has Been Liberalized

Great difficulty is being experienced by the War Minerals Relief Commission in finding claimants. A considerable percentage of the notices sent out, advising them of the liberalization of the law and conditions under which a rehearing of claims may be had, have been returned, due to change in the claimant's address. Only a few of the fifty claimants who were disbarred originally by the fact that their claims were not received within the time limit have been found. More than two years have passed since the commission has had any contact with these claimants, and now that their claims have been admitted to consideration, the War Minerals Relief Commissioner is anxious to obtain the present address of the miners who submitted the claims.

A hearing was conducted before the War Minerals Relief Commissioner on Jan. 6 and 7 on the claim of George H. Crosby and of the Whitmarsh Mining Co., of which Mr. Crosby is the president. The aggregate of the amounts claimed in these two cases is $385,818. John Lind made the principal argument for Mr. Crosby.

War Minerals Relief Commissioner Robinson concurs in the conclusion of the former commission that the expense of prospecting is not a proper item to include in a relief claim and that only expense incurred after discovery can be considered. Appeals have been taken on this particular point, however, and the Secretary of the Interior will be asked to rule on it.

As the activities of the War Minerals Relief Commission are now largely legal, rather than engineering, the commissioner is reporting directly to the Secretary of the Interior. The Bureau of Mines now has no formal relationship with the administration of the War Minerals Relief Act.

Permanent Tariff Bill Likely To Be Reported Soon

Senate Committee May Succeed by End of January—Some Leaders Against Measure

Unquestionably an earnest effort is being made by the Finance Committee of the Senate to report out the traiff bill at the earliest moment. Some of the Republican leaders, however, continue to be of the opinion that this is no time to attempt a permanent revision of the tariff and prefer to see the bill delayed still further.

The probabilities seem to be that the committee will be allowed to have its way, and that it will report out a bill before the end of January. Though it is known that there will be material changes in the House bill, including a material reduction in the level of most rates, no definite information as to its plans has gone out from the committee. The committee is supporting American valuation, but it is apparent that it is beset with uncertainties as to the possibility of making a practical application of that plan.

Consideration of the tariff on the floor of the Senate is certain to be more extended than usual. It is true that the Republicans have a majority of twenty-four in the Senate, but views on the tariff are much less partisan than they were when the Payne-Aldrich measure was enacted.

Hard Money Would Improve Currency Situation

In the light of the stabilizing effect of the use of gold and silver coin in Mexico as the sole circulating money, some economists in Washington are of the opinion that several European countries would improve their currency situations were they to do likewise. There also are some who believe important benefits would follow the more extended use of gold and silver, particularly gold, as circulating mediums, even in the United States.

Mining Dependent on Exports, Smith Points Out

Capacity of Country's Mines Greatly in Excess of 1921 Production—Petroleum a Shrinking Asset

That the mining industry is dependent to a material extent upon exports is pointed out by Dr. George Otis Smith, Director of the U. S. Geological Survey. Accurate calculations which have been made from the Survey's statistics show that the capacity of the coal mines of the country is nearly one-third larger than the peak of war production and is nearly double the 1921 output. The capacity of the country's copper mines is approximately equal to peak production, but is five times the 1921 output. The capacity of the iron mines of the country equals the blast-furnace capacity. It is double the peak production and is five times greater than the 1921 output. The capacity of the country's zinc mines is well above the maximum requirements ever placed upon them. The retort capacity is 20 to 40 per cent above peak production and from three to four times the 1921 output. In a recent public address, Dr. Smith made this statement:

"A measure of the rapidly increasing drafts we are making on our mineral balances in Nature's treasury is afforded by the fact that in the last fifteen years we have mined and smelted more lead than in nearly two centuries before; in the last thirteen years we have mined more coal and in the last eleven years more iron ore than in the whole of the century and more before; in the last nine years more copper than in the sixty-seven years before; and in the same nine years more zinc than in the fifty-four years since zinc mining began in the United States. Most thought-provoking, however, is the fact that our country has produced more petroleum since the outbreak of the World War than in all the years before August, 1914. In terms of these seven and one-half eventful years American petroleum is truly a shrinking asset."

NEWS BY MINING DISTRICTS

London Letter

Bwana M'Kubwa Capital To Be Reorganized — Burma Corporation's Plans Held Up—Cape Copper Reports Loss

BY W. A. DOMAN

London, Dec. 30—The Bwana M'Kubwa Copper Mining Co., which has been in existence for many years and has never made much return to the shareholders, is about to enter upon a new phase—upon something, in fact, which promises at least to be profitable to those who have risked their capital in the undertaking. A. B. Emery, who had much experience at the Messina copper mine, in the Transvaal, was recently employed by an influential group to examine the Bwana M'Kubwa, and he has made a satisfactory report. In brief, he says that the primary ore is of deep-seated origin; that the tonnage of ore estimated and classed as assured and reasonably to be expected down to only the 450 level is 3,000,000. He assumes, further, that 1,000,000 tons will be developed for each 150 ft. in depth below that level; the average grade is 4 per cent copper.

Minerals Separation has installed a plant at the property, and has obtained highly favorable results, and Mr. Emery has had checks made confirming the previous results. The Minerals Separation people apparently are strong believers in the future of the mine, for they are supporting the scheme for the reorganization of the capital. Shareholders are rather drastically treated, as for each fully paid share of 10s. each now held, they are to receive one share of 5s. each, credited with 2s. 6d. paid, the new capital being £400,000.

It does not yet appear that the Burma Corporation has derived much benefit from transferring its head office from London to Rangoon, though doubtless this is in part due to the fall in the price of metals. In 1919, the intention was to build a new smelter and refinery capable of producing 60,000 tons of refined lead and 6,000,000 oz. of silver annually, as well as to provide for the development of the Namma coal field. Owing to the financial slump, the board had been under the necessity of borrowing from the bank, and to conserve funds, the zinc works in India were closed, the erection of the smelter is uncompleted, and the development of the Namma coal field is postponed. At June 30, the ore reserves were estimated to be 4,369,686 tons, of an average grade of 23 oz. silver, 25.1 per cent, lead, and 17.6 per cent, zinc, the figures including 335,681 tons of copper ore assaying 11 per cent.

It is by no means a cheerful report that the directors of the Cape Copper Co. have presented to their shareholders for the twelve months ended Aug. 31. The company went to Rakha Hills, in India, with great hopes, which have been disappointed so far. There is a deficiency for the year of no less than £184,535, the total debit to profit and loss being £373,975. This disastrous result is attributed to loss on realization and revaluation of copper stocks, to heavy charges for interest, and to breakdowns in the power and other plant. No development was done at Rakha Hills during the period, and the ore reserves are estimated at 297,575 tons of 3.74 per cent copper, and 31,576 probable tons of 2.34 per cent copper. The balance sheet is far from healthy. Investments stand in the books at £103,-243, but the market valuation is only £72,681, and these investments are pledged to the bankers, whose advances, with interest, amount to £334,956.

KOREA

Oriental Consolidated Finds Labor Scarce and Unruly

Unsankinko — The Oriental Consolidated Mining Co. obtained $102,000 from its December cleanup. That for November was $101,946.03. Tonnage milled in November was 17,816. The Tabowie mill tonnage was lower than before, because there is so much waste to handle from the new shaft crosscuts and raises that it is impossible to furnish full tonnage for the mill.

The Taracol cyanide plant treated 2,042 tons of concentrate worth $53,-125.46 and secured $48,465.66 in bullion, an extraction of 91.2 per cent. The extraction is always good during cold weather. The mills are being run on steam power. Labor continues scarce. Those who do work are unruly.

SPAIN

Conditions Better in Mining Industry

The mining and metallurgical industries in Spain are improving to a slight extent, according to the Department of Commerce. Coal strikes in northern Spain have been abandoned by the miners involved without securing the concessions desired. The iron mines of Bilbao have experienced a resumption of activities due to the securing of contracts for 2,000,000 tons of ore for the export market during the coming year. Increasing cost of living and falling wages have aggravated industrial unrest.

BURMA

Namtu—The Burma Corporation's lead production for November was 3,899 tons gross: refined lead production 2,922 tons: refined silver production approximately 354,850 oz.

AUSTRALIA

Queensland

Mount Morgan Men Still Idle—Tin Mining in Progress—Sapphire Selling Agreement Canceled

Brisbane, Nov. 28—The Mount Morgan men have followed the advice of their leaders and refused to resume work under the 20 per cent reduction of wages awarded by the Arbitration Court, and the mine remains idle. Union leaders are trying to find work for some of the men elsewhere, but have not met with much success. The men, who are out of work and refuse to return to their jobs except at a wage which there is no possibility of the industry being able to pay, are receiving government allowances for food as well as a small dole contributed by other unionists. There are bitter complaints about the insignificance of this latter contribution, but the men are still standing out "on principle," which means no reduction of wages either at Mount Morgan or anywhere else.

It is unfortunate for Queensland that the many hundreds of miners who are out of work cannot be brought to see how effectually they are not only "killing the goose that lays the golden egg" at Mount Morgan, but have strangled the copper-mining industry of the state also. Though the Mount Morgan men will not work even at the wage fixed by the arbitration tribunal, the Cloncurry mining and smelting companies say it is quite impossible for them to resume operations at the rate awarded by that tribunal for the Cloncurry district. The minimum wage for a laborer in that district is 17s. 6d. per day, or 4s. more than that fixed for Mount Morgan, which is a gold as well as a copper mine. No mine in the commonwealth that only produces copper could pay the Cloncurry wage at the present time, much less the Cloncurry mines, which are more than 500 miles from port, but on every hand one hears of the fixed determination of all trade unions to accept "no reduction."

What this is leading to is being strikingly exemplified in the iron and steel trade. No part of the loan recently obtained by the Queensland government from New York can be devoted to the proposed iron and steel works at Bowen, but even if that were possible, it would be difficult to persuade the public that it would be wise to start those works at the present juncture. Owing to a scarcity of orders, the big works of the Broken Hill company at Newcastle, in New South Wales, are curtailing operations, and smaller concerns in the same industry

in that state announce their intention of completely closing down. The reason for this is that imported iron and steel is cutting out the locally manufactured product. It is asserted that wages are much lower, both in America and Great Britain, than in Australia, where they are said to be the highest in the world, and that iron and steel in the former countries, in spite of a protective tariff, can be manufactured and sent to Australia at a lower cost than it can be produced for here.

A small company operating the Tyrconnell mine, on the old Hodgkinson gold field, in North Queensland, has lately declared its first dividend. This field has been worked for over forty years, and the "oldest inhabitant" does not remember a company operating at this camp having ever before paid a dividend, though small individual operations in shallow ground ofted paid well years ago.

Despite the low price of tin, there is still considerable tin mining in Queensland. This is mostly done by small parties of men who possess their own "shows." At the richer mines the ore raised is at once disposed of at a profit, but in some projects of lower grade it is being held awaiting a better market. In others just enough is sold to provide the miners with "tucker," the rest being held for better times. In the Herberton district, inland from Cairns and one of the oldest tin-mining centers in the state, this class of mining is still much in evidence, and during the past quarter yielded 180 tons of tin oxide, valued at over £16,000. On the Kangaroo Hills field, north of Townsville, on which the now famous Sardine tin mine is situated, there was in the same period a yield of 137 tons of tin, worth £11,500. In the Stanthorpe district, in the extreme south, where four dredges are at work, the production of alluvial tin was worth about £2,500; and the Cooktown district, in the far north, with the aid of hydraulic sluicing, made an output of tin worth £3,000, notwithstanding a scarcity of water customary at this season. Of course, these returns are low compared with those of the same districts when tin values were about £200 per ton, but they are sufficient to show that the bottom has not entirely dropped out of this branch of mining in Queensland, as is almost the situation with copper.

The amended agreement with Messrs. Rubin Bros., of Paris, for the marketing of Queensland sapphires, has not been ratified by the government after all. The miners by ballot agreed to the main terms of this contract, though by only a small majority, but the firm asked that a limit be placed on the quantity of gems they might be called upon to take. The Minister for Mines refused to agree to this limitation, and the project has fallen through. There is therefore now open buying and selling on the Anakie field, as before the first agreement made with the Paris firm came into operation last January.

CANADA

British Columbia

Silversmith Mines Starts Operations at New Concentrator

Trail—Ore handled in 1921 at the smelter of the Consolidated Mining & Smelting Co. of Canada, Ltd., was slightly in excess of 400,000 tons, making a year's record for the quantity of material put through the furnaces. Low metal prices, however, made a decline in the value of the output, as compared with the preceding year, the figures being $6,694,865 and $7,326,925, respectively. There was 100 per cent increase in lead output compared with 1920, 44 per cent increase in zinc, 20 per cent increase in gold and 7 per cent increase in silver. Copper showed a decline of about 25 per cent. Comparative figures as to output for the two years are as follows:

	1920	1921
Gold, oz.	42,636	51,037
Silver, oz.	1,097,930	1,173,890
Copper, lb.	4,501,594	3,556,517
Lead, lb.	26,474,652	57,051,110
Zinc, lb.	36,995,394	53,131,270

The bulk of the smelter's tonnage was supplied by the company's mines. Of the total of 406,000 tons for the year, 399,196 came from this source. None of the company mines were operated on company account except the Sullivan and Rossland properties. The supposition is that the bulk of the 399,196 tons came from the Sullivan, in East Kootenay. This material is a highly complex ore, carrying silver, lead, and zinc. The Rossland mines, with values in gold and silver, furnished a part of the company tonnage, and the increased gold output indicates their operation at a slightly increased capacity in 1921 as compared with 1920.

Of the tonnage received from independent shippers, totaling 9,286, more than a third came from the state of Washington, the receipts from there being 3,888 tons. Nearly all of this came from Republic camp. The combined contribution of Slocan, Ainsworth and Lardeau districts was 2,785 tons, and East Kootenay independent shippers furnished 805 tons; Boundary-Similkameen districts, 890 tons; Rossland, 804 tons, and Nelson and Arrow Lakes districts 114 tons.

Sandon—The first of the year was marked by the starting of milling operations at the new mill of Silversmith Mines, Ltd., at this place. Silversmith's operation is practically the first milling activity in the Slocan within a year, a period of inactivity without a parallel in the history of the district. Ore reserves at the Silversmith mine are estimated as sufficient to maintain operation on a considerable scale for from four to five years. It is expected that about eighty men will be employed in general operations from now on. Output will go partly to Trail and party to Kellogg, Idaho, for treatment.

Nelson—The Consolidated M. & S. Co. has relinquished the bond held by it for some time upon the Ivy Fern group, on Cultus Creek.

Victoria—A. W. Bevan Allen, formerly secretary-treasurer of the Lucky Jim Zinc Mines, Ltd., whose holdings were transferred to Senator McMeans, of Winnipeg, and associates, under foreclosure proceedings last February, has secured a ninety-day option upon the property, which is situated in the Slocan, and if the necessary capital can be obtained, plans to organize a new company to be known as the New Lucky Jim Mines, Ltd., capitalized at $500,000. Senator McMeans and a number associated with him in the mortgage will be interested in the new company, if formed. The property, which has at different times in the past been noted for a remarkable high-grade zinc production, is extensively developed, and is regarded as having a future, under favorable conditions and management.

Kaslo—The No. 1 level of the Whitewater mine has been in process of cleaning out and retimbering by leasers, with a view to mining any ore left there under operations during the earliest history of the mine. Leasing operations have hitherto been confined chiefly to the lower levels.

Ontario

Kirkland Lake Properties Delay Cutting Wages—Foreclosure Proceedings Against North Crown Porcupine

Cobalt—The annual report of the Coniagas for the year ended Oct. 31, last, shows the company treated 113,279 tons, averaging 11.3 oz. per ton, and recovered 1,305,515 oz. which is considerably greater than for the three previous years. Costs were 33.5c. per oz., compared with 49c. the previous year, and an average during the life of the mine of 19.73c. an oz. The profit amounted to $400,000. The financial statement shows quick assets of $1,500,000. Ore broken on the stulls is over 100,000 tons. Total production to date is 29,490,000 oz., and dividends $10,940,000.

The Kerr Lake company announces that it will not consider the resumption of operations before next spring.

The winze at the Violet property, of the La Rose, has reached a depth of 600 ft., and crosscutting has been started. On the 530 level above, an ore shoot, averaging 33 oz. to the ton, was developed over a length of 225 ft.

No ore was shipped from Cobalt durin the week ended Dec. 31.

Kirkland Lake—Kirkland mines have not yet followed the action of the Porcupine companies in making a general reduction in wages, but it is anticipated that they will do so very shortly. Plenty of good men are available, and, as the new scale in Porcupine is above the Cobalt scale, there is now no partic-

ular reason why Kirkland should not follow suit.

It is stated that the Teck Hughes is treating approximately 160 tons per day, and that profits are running close to one thousand dollars a day.

Some high-grade ore is being taken from the shoot recently found on the 900 level of the Kirkland Lake Gold Mining Co.

As an indication of the manner in which the Kirkland camp is progressing, it is understood that the consumption of explosives increased 80 per cent during 1921.

Porcupine—In an address before the American Association for the Advancement of Science, A. F. Brigham, manager of the Hollinger, stated that this mine was producing gold at the rate of $11,000,000 a year. This means that eight northern Ontario mines are now producing at the rate of approximately $20,000,000 a year. When the power difficulty in Porcupine is finally settled, it will be found that this rate will be considerably exceeded.

The Vipond should realize $71,000 from the sale of its treasury stock, but its debts amount to $12,000 and it will cost $9,000 to unwater and put the plant in shape. The company will have $50,000 available for new work.

The Trusts & Guarantee Corporation, Ltd. have taken foreclosure proceedings against the North Crown Porcupine Mines, Ltd., claiming $200,000 principal and $4,871 interest, and four parcels of land aggregating 160 acres in Porcupine. The land comprises the Porcupine Crown and the Thompson-Krist mines. This action arose out of the failure of the Thompson-Krist company to put up money with the Porcupine Crown for development.

OREGON

Gold Hill District in Southwestern Section Active

Gold Hill—The Gold Ridge gold mine three miles south of Gold Hill, which began operating a 5-stamp mill early last summer has been making mill runs ranging from $1,500 to $1,700 weekly on a 10-hour shift. The company started running day and night Jan 1.

Two miles north of the Gold Ridge is the Millionaire gold mine, which was reopened last year at an expense of $100,000. It is an old time producer which was idle nearly 20 years. The present work consists of a new 200-ft. shaft and a new level drifting both ways on the vein. The mill equipment, which is reducing the ore from the new works and old dumps, consists of two 1,500-lb. Nissen stamps, rock crushers, amalgamating plates, and concentrating table, all driven with electric power.

One mile below the Gold Ridge mine is the Centennial placer diggings, which have been re-equipped at an expense of $110,000. The present equipment consists of a drag-type dredge.

One mile east of the Gold Ridge the Revenue "pocket" mine is being reopened.

MONTANA

Davis-Daly Awaiting Better Smelting Rates—East Butte Cutting Wages Jan. 16 With Other Companies

BY A. B. KEITH

Butte—Experienced miners have been so badly scattered by the prolonged shutdown that any material increase in production in the near future is regarded as out of the question by the Anaconda Copper Mining Co. The present surplus of copper will undergo a considerable shrinkage before Anaconda's resumption of operations, scheduled for Jan. 16, will have a telling effect, it is believed.

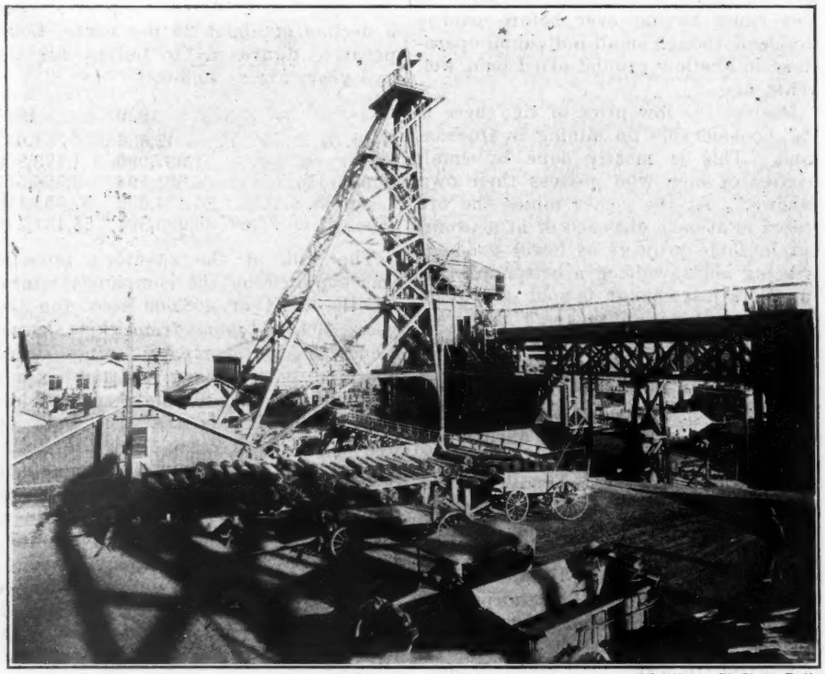
Anaconda has persisted in a policy of generally holding aloof from selling its copper at sacrifice prices and when the metal market has again regained its feet the company will be found offering its metal at somewhere in the neighborhood of what it cost to produce it. It showed assets amounting to approximately $68,000,000, consisting principally of unsold metal as of Dec. 31, 1921.

The advantages which lie in the direction of merchandising, it is said, first became apparent to the Anaconda company in connection with its Chicago white lead plant. From this cue the definite formulation of the idea to branch out in all the manufacturing lines which follow in the wake of the metals and minerals which it produces has resulted.

Copper shingles and its brass manufacturing plans temporarily have shaded the Anaconda company's fertilizer program. Unless Henry Ford's Muscle Shoals plans reach fruition along the popularly supposed lines, Anaconda in time will become the leading producer of fertilizer in the country.

The arsenic plant at the Washoe works was started some time ago as was the zinc works at Great Falls, and the Washoe smelter will get under way on a curtailed basis as soon as possible. Butte & Superior has started shipments of zinc concentrates to the Anaconda's electrolytic plant at Great Falls. The Anaconda is reported practically bare of zinc metal stocks and it plans immediate resumption of zinc production up to 6,000,000 to 7,000,000 lb. monthly.

The Davis-Daly Copper Co. will resume production just as soon as it is given what it considers to be fair smelting rates. With East Butte lopping off 50c. a shift beginning Jan. 16 and securing a reduction of $2 per ton of coke there is a possibility of it being able to offer the Davis-Daly better terms. The Anaconda also shortly will be starting its smelters and relief is looked for in this direction.



Schoettner Studios, Butte

ANACONDA COPPER MINING CO.'S ORIGINAL MINE, BUTTE, MONT.

The four mines of the Anaconda Copper Mining Co., at which operations will be resumed on Jan. 16 are the Badger State, Leonard, Mountain View and Mountain Consolidated, according to a report from Butte. The New York office said, however, that all the properties were in about the same condition and that those to resume might be other than the ones named.

WASHINGTON

First Thought Mine May Have New Concentrator

Orient—Interesting developments are expected this year at the First Thought mine, near Orient, which is credited with a notable production of gold in the past. It is possible that a mill will be built.

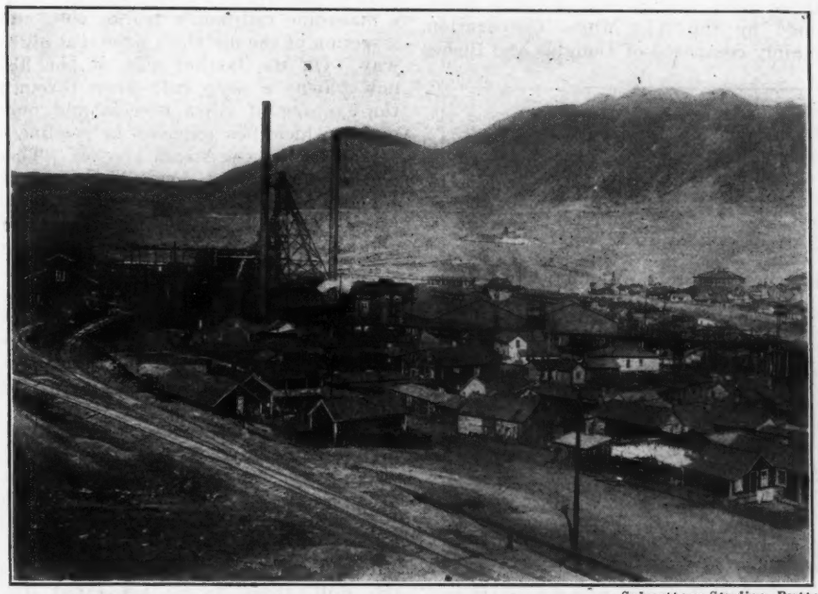
UTAH

Holiday Period Cuts Shipments From Tintic and Park City Districts

(From Our Special Correspondent)

Eureka—Shipments for the week ended Dec. 31 amounted to 110 cars, as compared with 156 cars the week preceding. The holiday intermission was responsible for the reduction. Shippers were: Tintic Standard, 41 cars; Chief Consolidated, 28; Iron Blossom, 10; Victoria, 10; Eagle & Blue Bell, 6; Swansea, 4; Grand Central, 4; Dragon, 3; Colorado, 3; Gemini, 1.

Some phenominally rich ore has been taken from the new strike at the Iron Blossom. A car shipped by a lessee from the Tintic Standard, which during 1920 shipped 2,824 cars of ore operating its mill and keeping up the output of shipping ores; and to shipments of fluxing ore from the Dragon and Iron King. A number of older properties at which lessees were operating also shipped silver ore. The second largest producer was the Chief Consolidated, which shipped 1,887 cars. The Eagle & Blue Bell, which early in the year reduced its working forces, nevertheless gave a good account of itself. The Victoria, the newer of the two properties, both of which are controlled by the Bingham Mines, made shipments almost equal to those of the older property.



Schoettner Studios, Butte

ANACONDA COPPER MINING CO.'S LEONARD NO. 2 MINE, BUTTE

ran 700 to 760 oz. silver, and is expected to bring about $35,000.

The output of the mines in the Tintic district in 1921 was 8,042 cars, or approximately 381,995 tons, as compared with 7,397 cars or approximately 351,357 tons in 1920. Tintic is a silver district producing silver-lead and dry siliceous ores. Early in the year there was a curtailment for a time in the output of dry silver ores, as the smelters found it was impossible to take too large a tonnage of these ores. This was due to suspension by a number of copper smelters, which were receiving little or no copper ores following the curtailment or cessation of operations by most copper producing mines (notably the Utah Copper) whose ores supplied the necessary fluxing charge for the dry silver ores.

A new process for the treatment of dry silver ores was worked out at the Garfield smelter of the A. S. & R., and shipments of dry silver ore from Tintic were resumed, and kept up, with the exception of another short intermission toward the end of the year, which was not important. The heavier tonnage is due to increased shipments

Toward the end of the year the Grand Central was reopened under a new plan. A large number of leases have been let here, and production is increasing. The Chief Consolidated began operating its limestone quarry during the year and shipped the material to the smelters and sugar factories of the state. This company also acquired new ground.

Shippers were: Tintic Standard, 2,824 cars; Chief Consolidated, 1,887 cars; Dragon, 568; Iron King, 509; Eagle & Blue Bell, 506; Victoria, 472; Iron Blossom, 453; Swansea, 162; Colorado, 137; Centennial-Eureka, 114; Gemini, 90; Grand Central, 86; Mammoth, 71; Bullion Beck, 69; Sunbeam, 46; Alaska, 27; Gold Chain, 26; Empire Mines, 22; Eureka Hill, 20; Eureka Mines, 17; Tintic Drain Tunnel, 7; Joe Bowers, 4; Yankee, 4; Ridge & Valley, 3; Eureka Bullion, 3; Little May, 3; Martha Washington, 2; Silver Park, 1; Showers, 2; Primrose, 1; Uncle Sam, 1; George Castleton, 1; Plutus, 1.

Park City—Shipments for week ended Dec. 31 amounted to 1,813 tons, as compared to 2,602, the lessened output being due to the holiday intermission. Shippers were: Judge allied companies. 827 tons; Silver King Coalition, 610; and Ontario, 325.

Park City during 1921 produced 83,414 tons of ore, compared with 102,187 tons the year preceding. Low metal prices and a controversy between two important producers, the Silver King Coalition and the Daly West, and one of the smelting companies, which resulted in a suspension of shipments by these companies for several weeks, were instrumental in bringing about the reduction. A new shipper came in during the year, the Park-Utah, one of the companies controlled by the same interests as the Judge, Daly and Daly West, and shipping under the head of the Judge allied companies. The list of shippers is as follows: Judge allied companies, 34,711 tons, compared with 41,571 tons in 1920; Silver King Coalition, 26,556 tons, compared with 25,829 tons in 1920; Ontario, 21,092 tons, compared with 25,929 tons in 1920; Naildriver, 1,005 tons, compared with 3,078 tons in 1920; and New Quincy, 50 tons.

NEVADA

Option on Middlemines Taken By M. R. Ward and Associates — Tonopah's Production Over $5,641,000 in 1921

Virginia City—An option has been taken upon the Middlemines on the Comstock Lode by Dr. M. R. Ward, president of the Tonopah Extension Mining Co., and associates. Detailed examination is planned.

Tonopah—The Tonopah *Bonanza* has compiled figures showing the 1921 production of the Tonopah district to be 340,924 tons of ore with a gross value of $5,641,371. Production was curtailed during nearly four months of the year due to walkout of miners and mill men on April 16 in protest against wage reduction, actual work not being resumed until September. The tonnage handled at the principal properties was as follows: Tonopah Belmont 124,304 tons, West End 75,000, Tonopah Extension 78,325, Tonopah Mining 50,000, and MacNamara 13,395.

The coroner's jury was unable to definitely ascertain the cause of the fire of Dec. 23, which destroyed the "Big Ship" boarding house, and in which three miners lost their lives and thirteen were injured. Considerable testimony was heard and there was evidence tending to prove the fire to have been of incendiary origin but the evidence was not specific enough to justify a decision to that effect. The general impression remains, however, that the fire was the work of radicals in an indirect attempt to interfere with mining operations in this district.

Eureka—The Uncle Sam Mining Co. has purchased the Hamburg mine, three miles south of the town of Eureka and adjacent to the Uncle Sam ground. The Hamburg is an old mine, long ago closed down in which several orebodies were developed to a depth of 850 ft. by vertical shaft and laterals. There is said to

be a large tonnage of ore of milling grade in the old workings, only the shipping ore having been extracted. The Uncle Sam tunnel is being driven to a connection with the old workings of the Hamburg with about 500 ft. yet to go.

Round Mountain—The placer season for this year has practically ended, and final cleanup by the Round Mountain Mining Co. will be completed in January. Production for the season was about $125,000. The recent heavy snows indicate an early and prosperous season for 1922. About forty lode leases are being operated in the Round Mountain district, the ore being shipped to the mill of the Round Mountain Mining Co. Although no lode mining is being done at present on company account it is likely that work will soon be started on promising veins exposed during the season's placer operations.

PHELPS DODGE CORPORATION'S NEW COPPER QUEEN CONCENTRATOR, WARREN DISTRICT, ARIZONA

ARIZONA

Work Stopped at Zonia Property—Amalgamated Copper Mines Co. Answers Condemnation Suit—Copper Queen Mill Nearly Ready

BY JAMES H. MCCLINTOCK

Phoenix—Operations have been suspended on the Zonia copper property, near Kirkland, permitting the assumption that sufficient ore has not been found to justify further expenditures. Deep exploration by shaft and tunneling has been pushed for the last eighteen months. P. G. Spilsbury was engineer in charge. It is understood that the work was backed by interests identified with the Inspiration Consolidated Copper Co.

In the local Superior Court, the Amalgamated Copper Mines Co. has filed answer to a condemnation suit against it, seeking entry upon its lands for the purpose of constructing a dam across Cave Creek, to hold water and thus secure protection for western suburbs of Phoenix, including the Capitol grounds. The answer recites that the proposed dam would injure the company in the sum of $200,000 and that the place chosen for the dam is an improper one, where no safe structure of the sort could be erected. Strong local demand is urging immediate construction of the dam. On Jan. 3 a large part of the western suburbs of this city, including a part of the Capitol grounds, was inundated by the discharge of Cave creek, which debouches upon the plain about twelve miles north of the city.

The Dos Cabezas Gold Ridge Mining Co. has been sued in Tucson by J. H. Huntsman, its president, who alleges indebtedness of $37,000, mainly on notes alleged due and payable. M. J. Kiley has been appointed receiver for the Schuylkill Mining Co., at Chloride.

Ajo—The Black Prince Mine, forty-three miles east of Ajo, is being developed by the Ajo Mines Corporation, mainly composed of Douglas and Bisbee mining men. The property, of ten claims, lately was deeded the corporation by John E. Newberry, trustee. A new shaft has been sunk 150 ft. A hoist has been moved from the Bisbee-Ajo to a property adjoining the old Gunsight, lately acquired by C. P. Sheehan, who has started upon deepening the 400-ft. shaft. The mine was worked as early as 1864, and at one time was known as the Ida.

Jerome—The shaft of the Verde Central mine is bottomed at 600 ft. in ore of commercial quality, in Yavapai schist containing much chalcopyrite. Drifting is to be started at once to determine the extent of the ore.

Returns from a carload of ore shipped by the Shea Copper Co. to El Paso give $111 a ton in gold, silver and copper and a net return, deducting freight, of $3,412. The ore was notably high in silver, averaging for the forty-seven-ton shipment nearly 100 oz. The copper averaged 4.82 per cent.

Douglas—A San Francisco corporation, the Painted Desert Mining Co., has leased the marble quarries of the Golden Rule Mining Co., forty miles from this point. The twenty-four claims of the group are said to include a large body of good marble. About $25,000 has already been expended upon the property.

A recent visit to Bisbee found operations of Phelps Dodge Corporation Copper Queen Branch, on Sacramento Hill, at a standstill, there appearing no present advantage in further development, inasmuch as the stripping of the remaining overburden can be conducted more advantageously at the time of ore extraction after the new mill shall have been put into operation. There are two ore zones of this low-grade deposit, known as the east and west orebodies. The stripping of the west orebody has been a rather delicate task, by reason of the fact that upon one side of the hill lies part of the city of Bisbee, together with a main-line railroad, a trolley line, and a section of the district's principal highway. On the farther side of the hill now yawns a deep cut, down through the capping of silica breccia and porphyry which lies exposed in readiness for attack by the steam shovels. This porphyry averages over 1½ per cent copper, though very high-grade ore is found in spots, including lenses of glance. Thus it happens that some smelting ore has already been steam-shoveled for the Douglas furnaces; also 180,000 tons of milling ore, which has been placed in a stockpile and over 315,000 tons of lower-grade, which has gone to the leaching heap near Don Luis.

The new Copper Queen mill lies two and a half miles from the hill, with which it is connected by a high-line, broad-gage road. The ore will be loaded on steel dump cars of twenty and twenty-five-cu.yd. capacity and transported to a crushing plant adjacent to the mill, there to be separated, the smelting, concentrating, and leaching ores thence being diverted to Douglas, to the mill, and to the leaching heaps. The leaching operation is an experiment, pure and simple, yet one believed to be worth while. There is expectation of recovery, within six years, of 70 per cent of the metal contained. This would appear a slow turnover of capital, but it is one attended with little more expense than if the material were piled as waste. Water for the mill is to be secured from the Calumet & Cochise shaft, just over the hill to the northward, where, from a station at 1,800 ft. depth, is being run a long drift. From this shaft is expected delivery of 1,200 gal. of fresh water a minute. This flows to a 1,000,000-gallon reservoir.

The leach ore will be washed with copper-bearing mine water. The leaching heaps are built 20 ft. high, with culverts provided through which oxidizing air may reach every part and through which the acid copper-bearing water may be conducted to a precipitation plant, where the metal will be recovered through its affinity for iron.

The new mill is close to completion, after plans made by H. Kenyon Burch. The mill is understood to have many

features resembling that at the Inspiration plant, though only one-fifth of the capacity of that 20,000-ton mill. Mill construction was started in June, 1918, but in October of that year was stopped, as, owing to war conditions, it was impossible to obtain steel. Construction work was resumed in August, 1919, and has been continuous since then. Most of the machinery and material was bought at high prices.

CALIFORNIA

Moment Position of Mining Industry in State

From Our Special Correspondent

San Francisco—With the opening of the year, gold mines of California, lode, drift, placer and dredger properties, are resuming to a marked extent. There has been sufficient readjustment of supply costs and wages and greater efficiency to give the gold miners a fighting chance at profits. In addition, many small prospects are being opened up under option; and thus there is vitality in the prospect situation. Grass Valley, Plymouth, Sutter Creek, Jackson and Melones have now resumed their customary activity and may be said to be approaching normal. The Mother Lode region further south is also active, although not to the extent of former years. Greater attention than formerly is being paid to drift mining and small placering. Gold dredges which were shut down because they were being worn out without securing profit are being put back into operation.

The copper companies are becoming interested in the increasing price of copper, but it is doubtful if copper mining will be resumed in the Shasta region until the copper price has made additional gains and lower costs are possible of attainment. The Plumas County copper districts are more or less active, with the Engels company operating at a good rate, but other mines engaged in desultory work. With a strengthening of the copper situation there should be a marked improvement here.

The Randsburg silver district has been very active and development upon claims other than discovery claims has been encouraging. Unless the litigation which has already started prevents, this district should give a good record in 1922.

The petroleum industry has recovered from labor troubles, and 1922 promises to be a record year for production, but it is not unlikely that new wells drilled will be fewer than in 1921. The industry as a whole is well consolidated and in a position to make the most of market possibilities as they develop.

E. E. Paxton, general manager of the Engels Copper Mining Co., has issued a formal reply to the charges made by Henry Engels, president of the company, in the letter recently sent out asking for proxies for the annual meeting on Feb. 13.

MICHIGAN

The Copper Country

Copper Range Mines Gradually Increasing Force — Favorable Report on Mohawk Expected

BY M. W. YOUNGS

Houghton—Working forces are being gradually built up at the Copper Range mines, particularly at Champion, which added about seventy-five men to its underground crew in December. Champion's production has been steadily increasing from month to month, the daily tonnage now being 2,400 or approximately 62,000 tons a month. The yield here has fallen off only slightly and is now about 39 lb. to the ton, refined. Baltic is hoisting around 16,000 tons of rock per month and Trimountain, 13,000. There is no change in yield in these mines and Trimountain is maintaining the improvement in quality of rock that has been in evidence for several months. Production, refined, for the three mines is estimated at 2,700,000 lb. per month, which is 60 per cent of the output of normal years such as 1915 and 1916. As men are taken on the amount of drifting being done in Champion and Baltic is increased and a full program of opening work will be under way in both of these mines in another month. A heavy program of drifting has been in progress at Trimountain for several months.

A most favorable report on Mohawk operations in 1921 is expected here. Mohawk increased production last year and was able to materially reduce costs. It cost Mohawk 13.1c. per lb. in 1920 and it is believed the 1921 report will show costs under 12c. It also is believed Mohawk received close to 13c. per lb. for copper sold in 1921 and that earnings were somewhat in excess of 1c. per lb. Based on estimated production of 14,000,000 lb., Mohawk should report a net profit of approximately $1.50 per share on 1921 operations. No construction work involving heavy costs is contemplated at Mohawk this year. Connection, however, will be made with the Calumet & Hecla water system, which was extended north last fall. This will enable Mohawk to drain all of its wells and other surface water which will result in a lessening of mine pumping costs.

Arcadian Consolidated has reached a depth of 1,050 ft. in its new sinking operations in the New Baltic shaft, which is being lowered from the 942 level to a depth of about 1,100 ft. to correspond with the 1,050 level of the New Arcadian shaft. The shaft is again in the vein and the rock being brought to surface is heavily charged with copper. The shaft was sunk 108 ft. in December and should reach its objective about the middle of January. A drift south will then be started. Work in the south drift from the 9th level has been resumed and the vein here is also yielding a splendid grade of rock.

No. 2 Gratiot shaft of the Seneca will be one of the most modern shafts in the district. It will have three compartments. Work of preparing the shaft for a resumption of sinking is progressing favorably. The steel work for the collar is completed and ready for the pouring of concrete. It will be necessary to clean out the shaft, widen it and put in new timber before sinking can be resumed. It is expected the shaft will be ready for sinking and the new hoist, now on the ground, installed by spring. Opening work in the Seneca shaft from the 3rd to the 7th levels, inclusive, continues.

Mayflower reports an improvement in the north drift at the 1,450 level. At the 1,750 level work is still proceeding in the crosscut through the fault encountered in the south drift.

Calumet & Hecla shipped over 2,000,000 lb. of copper by rail in December.

JOPLIN-MIAMI DISTRICT

Tailings Pond Dam Dynamited at Circle Mine — Severe Storm Damages District Properties—Vantage Co. Makes Record Output

BY P. R. COLDREN

Joplin — A boy's quarrel over the privilege of skating on the mill pond of the Connecticut Zinc Co.'s Circle mine at Oronogo, Mo., resulted in dynamiting the pond dam and causing damage that will prevent the property from starting operation the middle of January, as had been planned. It is expected that repairing the damage and getting fresh water into the dam will require the better part of a month. The Circle mine, which has the largest and most complete concentrator in the entire Tri-State field, has been idle for over a year. A. J. Burnham, of Joplin, is district manager.

An unusual wind and hail storm, accompanied by an electrical disturbance, caused considerable damage to city and mining property in this field on the night of Jan. 3. The Premier mine lost a dummy elevator and smokestacks. The St. Joe mine lost smokestacks. The Black Hawk mine lost a tramway. And part of mills of the Bluebird and Skelton companies were materially damaged.

An exceptionally good output record is reported by the Vantage Co., of Picher, Okla. At the company's No. 1 mine at Picher a total of 7,293 tons of zinc ore and 3,808 tons of lead ore was produced from only 79,476 tons of dirt. The recovery of the zinc was 9.17 per cent (in local parlance) and that of lead 4.79 per cent, or a total of 13.96 per cent. O. A. Sneed is superintendent.

MEXICO

Parral—Seventeen men were killed by a landslide at San Francisco del Oro, near Santa Barbara, recently. They were employed in digging down an old tailings dump to be re-treated in the new mill erected by the San Francisco del Oro Mining Co., when the upper part caved. Others went to their rescue, and while attempting to uncover them a second slide added two more to the death list.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
5	13.50	31.75	32.25	4.70	4.375@4.40	4.80
6	13.50	31.875	32.375	4.70	4.375@4.40	4.80
7	13.50	32.00	32.625	4.70	4.375@4.40	4.75@4.80
9	13.50	31.875	32.375	4.70	4.375	4.75@4.80
10	13.50	31.875	32.25	4.70	4.375	4.75 - 4.775
11	13.50	31.75	32.375	4.70	4.375	4.75

*These prices correspond to the following quotations for copper delivered: Jan. 5 to 11 inc., 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
5	66	66⅞	73½	167⅝	169½	24⅜	24⅜	27	27⅜
6	65⅝	66½	73½	167¾	169¾	24½	24⅜	27⅛	27½
7	...	...	...	.....	.....	...	...	...	...
9	65⅞	66¾	73½	166¾	168¾	24⅜	24⅜	26⅞	27¼
10	65⅜	66¼	73	165¼	167	24½	24¼	26⅜	27⅛
11	65¼	66	73	165⅝	167⅜	24⅜	24¼	26½	26⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver			Jan.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
5	418	99⅝	64¼	34½	9	421½	99⅝	66¼	35⅛
6	419¼	99⅝	64⅞	34⅞	10	422½	99⅝	66⅜	35½
7	419½	99⅝	64⅞	34¾	11	422¼	99⅝	66	35⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Jan. 11, 1922

No buying of importance has yet marked the new year. Some large consumers of copper have been in the market, but trading in all of the metals has been exceedingly quiet so far as most trading interests are concerned. It is generally believed, however, that the lull is only a temporary one, inasmuch as general business conditions seem to be unimpaired. Cheap call money, at 3½ per cent today, is a favorable factor.

Copper

Some of the large producers have shown a tendency to meet the market during the last week, and it is possible to buy at 13.75c. delivered in an increasing number of directions. Some large orders have been booked during the week at this price, as well as somewhat above, when later deliveries were wanted. Trading in small lots of one or two hundred tons has been very meager indeed, and this has made the market appear more quiet than usual when, as a matter of fact, domestic sales have mounted into a higher tonnage than for several weeks. It is significant that some of the larger interests are considering copper purchases at present prices advisable. The wire business seems to be good. Brass makers are not expected to be in the market much before February.

Export sales have fallen off somewhat during the last week, though the Export Association has booked some business to the usual destinations at 14.125c. c.i.f. European points. Outside interests have cut this price 10 to 15 points without stirring up much business. Foreign buying is no doubt affected by the deliberations of the conference which has recently assembled at Cannes.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c., a level which has now been maintained for almost four months. The New York market has been quiet at unchanged prices, although there is somewhat less disposition to charge more than 10 points' premium on corroding grades. Although sales have not been large, producers are not pressing any metal on the market; in fact, many of them have entirely sold their January output, and are willing to accumulate a little lead if necessary, believing higher prices sure to come. The European demand is holding up particularly well, and prices are being realized somewhat above London parity in many instances. No more sales of domestic lead to foreign buyers have been reported, but this possibility is always near with the present condition of the market.

In St. Louis there has been some pressure, and the 4.40c. quotation of last week has not been maintained. Careful buyers were able to get lead for 4.375c. as early as last Thursday; in fact large lots could no doubt have been obtained at all times at this price had any one wanted them. Some producers continue to quote 4.40c., but they are the ones who are not at all anxious to sell. Freight rates in Central Freight Association territory have not yet been adjusted to the satisfaction of all parties, and another meeting is scheduled for Chicago on the seventeenth at which the matter should be settled.

Zinc

The market has been noticeably softer since Saturday of last week, although several producers dropped out of the market when it became apparent that a decline was inevitable. Zinc was sold in a fairly large tonnage on Saturday for 4.775c. and on Tuesday for 4.75c., St. Louis, which is the market today. The decline is attributed to the lessening of demand from the steel industry more than to any pressure on the part of producers to dispose of their production. Trading has not been particularly heavy, and the lower prices have not produced additional business. High-grade zinc continues to be in good demand at 6c. with freight allowed.

Tin

Consumers have taken average amounts of tin during the last week, prices varying but little from day to day. The tin-plate orders reported do not seem to have activated the market to any great extent. The interest involved probably bought large quantities of tin last month. Chinese tin is again being offered here for January shipment, and was yesterday obtainable at about three-quarters of a cent under the price asked for spot Straits. American electrolytic is still available only in extremely limited amounts, but there seems to be some prospect that Bolivian producers will again begin shipment soon, as they are better satisfied with present prices. Production of concentrates was virtually suspended when the price of tin dropped to around 25c. last fall.

Straits tin for forward delivery has sold at approximately the same prices as spot.

Arrivals of tin, in long tons: Jan. 3d, Straits, 150; 6th, Liverpool, 25; London, 50; 9th, Straits, 375.

Gold

Gold in London: Jan. 5th, 98s. 4d.; 6th, 97s. 11d.; 9th, 97s. 6d.; 10th, 97s. 2d.; 11th, 97s. 5d.

Foreign Exchange

Foreign exchanges have generally advanced since our last report a week age. On Tuesday, Jan. 10, francs were 8.305c.; lire, 4.3125c.; and marks, 0.58c. New York funds in Montreal, 6⅞ per cent premium.

Silver

An improvement in Shanghai and Hongkong exchange rates has brought China into the market again as a buyer. The Indian bazaars also bought, although there have been resales from this quarter. Sales of silver from the Continent continued. The result of these factors has brought about higher prices in both London and New York, to which the strength of sterling exchange has contributed in local prices.

Mexican Dollars—Jan. 5th, 48⅜; 6th 49⅜; 7th, 49⅜; 9th, 50⅜; 10th, 50⅜; 11th, 50¼.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 4.50c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb.

Cadmium—$1@$1.10 per lb. in 1,000-lb lots. Smaller quantities, $1.10@$1.25 per lb. Demand is somewhat improved.

Palladium—Nominal, $55@$60 per oz.

Platinum—$84@$93 per oz. Market stronger.

Quicksilver—$52 per 75-lb. flask. San Francisco wires $48.70.

The prices of the following metals remain unchanged from the figures published in these columns on Jan. 7: Bismuth, Cobalt, Iridium, Molybdenum, Monel Metal, Nickel, Osmium, Rhodium, Selenium, Thallium and Tungsten.

Metallic Ores

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Jan. 7 issue: Chrome, Iron, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 7—Zinc blende, per ton, high, $31.10; basis 60 per cent zinc, premium, $29; Prime Western, $28; fines and slimes, $27@$25; average selling price, all grades of zinc blende, $28.56.

Lead, high, $62.80; basis 80 per cent lead, $60; average settling price, all grades of lead, $58.96 per ton.

Shipments for the week: Blende, 7,925; lead, 3,226 tons. Value, all ores, $418,550.

Purchases this week were about 7,000 tons, 925 tons under the shipment, marking a further decrease in reserve stocks. Outputting is estimated at from 6,000 to 6,500 tons. Although a number of mills have been restarted, this has little apparent bearing on an increase of production, which is explained by prominent mine owners and buyers by the fact that the mines that were producing steadily during the last year cut the ore reserves almost to nothing and are weekly showing a lower production record. It is likewise contended that with all mines preparing to start, the output will not reach the highest level of 1921, and it is believed it cannot average as high as the 6,300-ton average of last year.

Platteville, Wis., Jan. 7—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $58 per ton. Shipments for the week: Blende, 370 tons to smelters and 780 tons to separating plants.

Non-Metallic Minerals

Generally dull markets exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Jan. 7 issue: Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Kaolin, Limestone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur and Talc.

Mineral Products

Sodium Sulphate — For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $18@$21 per ton, New York.

Prices of Copper Sulphate, Potassium Sulphate and Sodium Nitrate are unchanged from the quotations published Jan. 7.

Ferro-Alloys

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Jan. 7 issue: Ferrotitanium, Ferrocerium, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium and Ferrovanadium.

Metal Products

Prices of Copper Sheets, Lead Sheets, Nickel Silver, Yellow Metal, and Zinc Sheets are unchanged from the quotations published on Jan. 7.

Refractories

Prices on the following are unchanged from the figures published in the Jan. 7 issue: Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick and Silica Brick.

The Iron Trade

Pittsburgh, Jan. 10, 1922.

Production of steel ingots was at the rate of 20,000,000 tons a year in December, against fully 23,000,000 tons in October and November, the highest rate since February. There was a sharp decline in the rate in the latter part of December, and operations have not regained the former rate yet, though they probably will by the end of this month.

Operations are heaviest at the pipe mills, and the sheet, tin plate, and wire mills come next in order. Production of bars, shapes, plates, and rails is light.

The finished-steel markets have been quiet since the first of the year, except that some interests have had heavy bookings of tin plate, which promises to be in full demand in 1922. Demand for tubular goods has been falling off.

Steel prices have been practically stationary for three weeks, the only change recently, a minor one, being a reduction from 3.75c. to 3.50c. in the price of the American Steel & Wire Co. for cold-rolled strip, following price cutting by independents.

Pig Iron—W. P. Snyder & Co. have sold 1,500 tons of bessemer to an Ohio manufacturer at $19.50, furnace, or 50c. under the price nominally quoted since Aug. 1. Basic is altogether inactive. There was a fair movement in foundry iron in December, for January and February shipment, the market now being dull. We quote: Bessemer, $19.50; basic, $18.25; foundry, $19.50 to $20, Valley, freight to Pittsburgh being $1.96.

Coke

Connellsville — Furnace, $2.75@$3; foundry, $3.75@$4.50.

American Brass Output in Ten Years

Not until the subject of a merger with the Anaconda Copper Co. opened up the affairs of the American Brass Co. to greater publicity have even the shareholders of that concern had an adequate conception of the size of its business, according to the *Boston News Bureau*. The part that the company played in the war is visualized in the production of finished materials in the years of 1916, 1917 and 1918, in one of which it produced 564,853,928 lb. of fabricated copper and brass. We trace the output by years since 1911 (in lb.)

1911	233,839,101	1916	497,824,042
1912	312,461,536	1917	500,790,548
1913	297,253,789	1918	564,853,928
1914	233,961,384	1919	369,591,018
1915	387,059,514	1920	405,178,719
Total	1,464,575,324	Total	2,337,738,255

It will be seen that in the five years from 1916 to 1920 inclusive American Brass produced over 1,160,000 tons of finished goods, an amount which explains why the company has long been known as the world's largest copper consumer. In some of the periods enumerated it must have melted into brass or fabricated into copper wire or sheets well over 350,000,000 lb. of copper.

During the twenty years ended Dec. 31, the company earned a gross profit of $78,155,000, against which it charged almost $25,000,000 for improvements and depreciation, leaving a net profit of $53,768,000, or $377.54 per share on the company's 150,000 shares. These profits were in large measure expanded by the huge war demand for the company's products. Today its mills are running at little or no profits, as for the first nine months of 1921 the operating loss was $2,193,000.

Dividend Records of Ontario Mines

Up to the end of 1921 dividends paid by the gold and silver mines of northern Ontario amounted to $115,437,727. In view of the fact that the Cobalt camp was discovered late in 1903, and hardly began producing until 1905, this record is one of which Ontario can well be proud. Dividends paid by the Cobalt mines amount to $92,283,820, which represents practically 50 per cent of the gross value of the production. Porcupine mines have paid $22,355,281, and Kirkland mines $798,625.

The following is a list of mines which have paid $2,000,000 or over, and it will be seen that Nipissing is the outstanding company and is likely to maintain this position for a considerable time.

1.	Nipissing	$24,223,297
2.	Hollinger	16,558,000
3.	Coniagas	10,940,000
4.	Kerr Lake	9,160,000
5.	La Rose	7,505,409
6.	Crown Reserve	6,190,849
7.	McKinley	5,955,391
8.	Mining Corporation	5,499,867
9.	Buffalo	3,637,000
10.	McIntyre	2,548,198
11.	Dome	2,397,083
12.	Temiskaming	2,159,156

In addition to the above companies, twenty-five other mines have paid a total of over $18,000,000.

Transvaal Gold Production

The following table summarizes Transvaal gold production since 1917:

RAND GOLD OUTPUT, 1917–1921, IN FINE OUNCES

	1921	1920	1919	1918	1917
January	681,382	670,503	676,059	714,183	782,634
February	671,123	625,330	636,728	659,759	721,321
March	588,137	707,036	712,379	696,281	787,094
April	651,593	686,979	694,944	717,099	742,778
May	687,776	699,041	724,995	741,217	729,385
June	678,490	715,957	702,379	727,696	759,724
July	689,555	736,099	725,497	736,199	757,890
August	711,526	702,083	706,669	740,210	756,658
September	691,026	682,173	698,558	708,206	738,231
October	707,825	662.472	723,722	679,764	751,290
November	704,236	633,737	677,970	658,701	722,839
December	.....	632,215	650,191	641,245	722,419

Ore and Metal Movements for November, 1921

Imports and exports of the more important metals and ores as reported by the Department of Commerce for November, 1921, and the figures for November, 1920, as finally revised, are as follows:

IMPORTS, NOVEMBER, 1920 AND 1921

In Pounds, Unless Otherwise Stated

	November 1920	November 1921
Antimony ore, contents	71,591	.....
Antimony matte, regulus or metal	354,699	1,545,895
Brass, fit only for remanufacture	8,010,304	8,516,832
Copper		
Ore, contents	3,320,237	5,669,284
Concentrates, contents	2,895,750	1,414,356
Matte and regulus, contents	927,623	213,943
Imported from		
Spain	1,147	1,003,920
Canada	1,786,384	419,716
Mexico	3,030,498	45,706
Cuba	.....	2,187,558
Chile	1,942,902	2,833,889
Peru	256,499	82,560
Venezuela	.....	514,291
Other countries	126,180	209,943
Unrefined, black and blister	20,827,205	10,561,454
Refined, in bars and plates	8,319,937	7,825,099
Old, for remanufacture	1,556,453	2,091,382
Composition metal, copper chief value	444,493	47,762
Lead		
Ore, contents	931,431	928,773
Bullion, contents	18,985,702	12,197,411
Imported from		
Canada	635,830	555,167
Mexico	19,262,918	12,359,496
Other countries	18,385	211,521
Pigs, bars, and old	7,716,344	2,916,234
Manganese ore, long tons	74,477	8,620
Imported from		
Cuba, long tons	1,040	.....
Brazil, long tons	44,900	8,600
British India, long tons	17,250	.....
Tungsten ore, long tons	272	83
Pyrites, long tons	8,600	28,057
Imported from		
Spain, long tons	.....	26,597
Canada, long tons	5,600	.....
Tin ore, long tons	2,831	854
Bars, blocks and pigs	9,550,535	6,886,085
Imported from		
United Kingdom	336,250	478,220
British Straits Settlements	6,992,086	5,828,407
Hongkong	1,930,999	225,379
Australia	123,200	197,120
Zinc		
Ore, contents	2,752,221	.....
Imported from		
Mexico	2,752,221	.....
Zinc dust	410	29,724

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds	November 1920	November 1921
Copper		
Ore contents	(a)	(a)
Concentrates, contents	(a)	(a)
Unrefined, black and blister	58,343	40,683
Refined, in ingots and bars	38,496,030	69,377,438
Exported to		
Belgium	1,861,441	1,793,752
France	12,987,092	12,813,094
Germany	6,347,098	27,362,115
Italy	112,087	6,519,079
Netherlands	3,350,232	3,352,404
Spain	.....	1,850,666
Sweden	1,916,865	1,927,358
United Kingdom	4,738,717	2,576,124
Canada	1,424,510	3,605
Japan	.....	5,251,936
Other countries	1,757,988	5,927,305
Composition metal, copper chief value	173,834	6,167
Old and scrap	132,892	102,079
Pipes and tubes	338,425	85,656
Plates and sheets	913,767	416,432
Wire, except insulated	2,499,075	423,466
Lead		
Pigs and bars		
Produced from domestic ore	274,062	183,557
Produced from foreign ore	1,019,382	11,726,575
Exported to:		
United Kingdom	.....	6,722,048
Canada	49,065	69,971
Argentina	224,000	31,997
Brazil	725	224,013
China	.....	11,200
Japan	672,000	336,000
Other countries	347,654	4,514,903
Zinc		
Dross	567	61,690
Spelter		
Produced from domestic ore	72,379	185,959
Produced from foreign ore	50,126	.....
Exported to:		
France	.....	56,028
Canada	34,506	.....
Mexico	53,636	6,530
Other countries	34,363	123,401
In sheets and strips	1,118,063	276,974

(a) No exports.

COMPANY REPORTS

The Coniagas Mines, Ltd.

A report of operations of the Coniagas Mines, Ltd., for the year ended Oct. 31, 1921, shows a net profit of $347,378.11. Three dividends were paid, one of $600,000 and two each of $100,000. Silver output totaled 1,301,515 oz., for which 70.80c. per oz. was realized and which cost 33.52c. per oz. to mine and concentrate. Smelting, refining, shipping, and marketing costs amounted to 6.33c. Working and loss and gain accounts follow:

Debit	
Head office and administration	$ 16,563.29
Mines' office and supervision	26,634.34
Camp expense	44.63
Lands and roads	471.11
Mining	132,753.83
Sale of ore and bullion (refining, treatment, and other charges)	82,416.00
Legal expense	1,259.93
Milling	212,832.79
Transportation and traveling	694.60
Taxes and royalties	33,108.43
Fire insurance	4,289.68
Maintenance of houses	3,831.84
Employees' bonus	4,011.12
Loss and gain	398,722.01
	$ 917,633.60
Credit	
Silver revenue	$ 911,555.06
Copper revenue	991.60
Camp revenue	187.00
Rents	4,309.25
Cash discounts	590.69
	$ 917,633.60

LOSS AND GAIN ACCOUNT

Debit	
Donations and sundry expense	$ 678.94
Directors' fund	3,000.00
Maldens McDonald and Montgomery Maldens properties net expenditures	635.56
Examining prospects	5,838.82
Flume construction expense	8,137.19
Adjustments on account of previous years' operations	20,802.37
Profit before providing for depreciation and other reserves	422,238.93
	$ 461,331.81
Credit	
Balance from working account	$ 398,722.01
Sundry sales	141.56
Interest on Victory loan bonds	52,334.94
Bank and other interest	4,323.14
Interest charged to the Coniagas Reduction Co. Ltd.	5,810.16
	$ 461,331.81
Debit	
Profits for year before providing for depreciation and other reserves	$ 422,238.93
Adjustment of reserve on account of Victory loan bonds	19,157.50
	$ 441,396.43
Credit	
Reserve for contingencies	$ 18,288.32
Reserve for depreciation accrued	28,000.00
Amounts written off properties	47,730.00
Net profits for year	347,378.11
	$ 441,396.43
Debit	
Dividend No. 51 $ 600,000.00	
Dividends Nos. 52 and 53 200,000.00	$ 800,000.00
Balance	$ 1,695,889.78
	$ 2,495,889.78
Credit	
Balance Nov. 1, 1920, brought forward	$ 2,148,511.67
Net profit for year	347,378.11
	$ 2,495,889.78

Capitalization is 800,000 shares of $5 each, fully paid.

Camp Bird, Ltd.

A report of operations of Camp Bird, Ltd., for the year to June 30, 1921, states that all operations on the Camp Bird mine were suspended on Nov. 30, 1920, and the property was on that date placed in care of watchmen. In the opinion of the general manager, however, the work was not considered as completed, nor was the outlook discouraging. The accounts for the year show a surplus of expenditure, £17,535, and the company carries forward a balance of £19,905, against £37,440 brought in. The company's holding in the Santa Gertrudis Co., Ltd., is 808,351 shares.

Sulphide Corporation

A report of operations of the Sulphide Corporation, Ltd., for the year ending June 30, 1921, states that the past year has been one of much anxiety owing to the prolongation of the Broken Hill strike until early in November, 1920. The award as to wages, hours of work and other conditions, coupled with the heavy fall that has since taken place in the price of the metals which the corporation produces, has made work at Broken Hill extremely difficult and precarious. Nevertheless mining and milling operations were recommenced about the end of November, 1920, and have since been continued under the new and adverse conditions which have prevailed.

Operations at the mine and smelting works have resulted in a small working profit of £2,480, although, apart from the profit obtained from the acid and superphosphate plants at Cockle Creek, there would have been a substantial loss.

This working profit has been augmented by sundry credit items in the profit and loss account, due mainly to successful trading in lead and to interest and profit on investment, the final net result being a profit of £30,009.

The tonnage of bullion treated in the refinery was 15,102 tons which yielded:

Gold, Oz.	Silver, Oz.	Soft Lead, Tons	Antimonial Lead, Tons
6,189	1,298,985	12,649	35

Mexican Corporation, Ltd.

A report of operations of the Mexican Corporation for the year ended June 30, 1921, shows that after allowing for interest paid and accrued on the seven-year notes and writing off £11,472, or one-third of the expenses of the issue, there was an excess of expenditure amount to £38,427, which has been carried forward. The corporation has now advanced to the Mexican company—the Mexican Corporation S.A.—£1,132,813.

The plant on the Fresnillo mine began operations at half capacity in August, and will, it is anticipated, be completed and working at full capacity—75,000 tons per month—in December. The general manager anticipates that on this basis, and with silver at 62½c. per fine oz., there will be a gross working profit of $75,000 per month.

At the Teziutlan property smelting was discontinued owing to the low price of copper, but recently a high-grade orebody has been struck, which promises well when operations are resumed.

The English company's holding in the British Equatorial Oil has not been increased since the closing of the accounts. Advice has been received of oil having been struck in the first well drilled on this company's property in Venezuela.

Santa Gertrudis Co., Ltd.

A report of operations of the Santa Gertrudis Co., Ltd., for the year ended June 30, 1921, states that during the period there was treated 475,360 dry tons of ore, of which 200,487 was received from the Santa Gertrudis mine and 274,873 from the El Bordo. The bullion recovered contained 21,680 oz. fine gold and 4,533,338 oz. of silver. The financial result to the milling company does not appear in the report, but no dividend was declared by it. Santa Gertrudis, Ltd., the English company, had a balance over from 1919-20 amounting to £28,982, and after paying the expenses of the year and interest on the 8 per cent five-year notes, and writing off £10,000 or one-third of the expenses of issue of the notes, there was a balance left to carry forward amounting to £453.

The operations of the year were adversely affected by the shortage of power, owing to drought, and the earnings were seriously reduced by the fall in the price of silver. The advisory engineer considers that a reduction in costs is to be looked for within a reasonable time.

MINING STOCKS

Week Ended January 7, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	63	60	60	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	2⅛	1⅞	1⅞		
Alloues	Boston	24	24	24	Mar. '19	1.00
Anaconda	New York	50⅛	47⅛	49	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3⅛	3	3		
Ariz. Com'l	Boston	9⅛	8⅛	8⅛	Oct. '18, Q	.50
Big Ledge	N. Y. Curb	*27	*25	*27		
Bingham Mines	Boston	13	13	13	Sept. '19, Q	.25
Calumet & Arizona	Boston	59	57	57⅛	Dec. '21 Q	.50
Calumet & Hecla	Boston	273	265	265⅛	June '20, Q	5.00
Canada Copper	N. Y. Curb	*38	*35	*35		
Centennial	Boston	9⅛	9⅛	9⅛	Dec. '18, SA	1.00
Cerro de Pasco	New York	34⅛	32⅛	32⅛	Mar. '21, Q	.50
Chile Copper	New York	16⅛	15⅛	15⅛		
Chino	New York	27⅛	26⅛	26⅛	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	†*16	†*11	*11⅛		
Con. Arizona	N. Y. Curb	*4	*2	*3	Dec. '18, Q	.05
Con. Copper Mines	N. Y. Curb	1⅛	1⅛	1 1/16		
Copper Range	Boston	39	37⅛	37⅛	Sept. '20, Q	.50
Crystal Copper	Boston Curb	*64	*61	*63		
Davis-Daly	Boston	6⅛	6⅛	6⅛	Mar. '20, Q	.25
East Butte	Boston	11⅛	10⅛	10⅛	Dec. '19, A	.50
First National	Boston Curb	*80	*75	*80	Feb. '19, SA	.15
Franklin	Boston	†2⅛	†1⅛	1⅛		
Gadsden Copper	Boston Curb	†*50	†*40	*50		
Granby Consol.	New York	28⅛	26⅛	26⅛	May '19, Q	1.25
Greene-Cananea	New York	27⅛	26	26	Nov. '20, Q	.50
Hancock	Boston	2⅛	2⅛	2⅛		
Howe Sound	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '21, Q	.05
Inspiration Consol.	New York	40	38	38⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7⅛	7	7	Sept. '20, K	.25
Isle Royale	Boston	23⅛	23⅛	23⅛	Sept. '19, SA	.50
Kennecott	New York	26⅛	25⅛	26	Dec. '20, Q	.50
Keweenaw	Boston	1⅛	1⅛	1⅛		
Lake Copper	Boston	2⅛	2⅛	2⅛		
La Salle	Boston	1⅛	1⅛	1⅛		
Magma Copper	N. Y. Curb	28⅛	26⅛	27⅛	Jan. '19, Q	.50
Majestic	Boston Curb	†*5	†*3	*4		
Mason Valley	Boston	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	3	2⅛	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	27⅛	26⅛	26⅛	Nov. '21, Q	.50
Michigan	Boston	2	2	2		
Mohawk	Boston	55	54	54	Nov. '20, Q	1.00
Mother Lode Con.	N. Y. Curb	7⅛	6⅛	7⅛		
Nevada Consol.	New York	15	14⅛	14⅛	Sept. '20, Q	.25
New Cornelia	Boston	18	17⅛	17⅛	Aug. '20, K	.25
North Butte	Boston	13⅛	12⅛	12⅛	Oct. '18, Q	.25
North Lake	Boston	†*25	†*20	*24		
Ohio Copper	N. Y. Curb	....	....	*8		
Old Dominion	Boston	23⅛	23	23	Dec. '18, Q	1.00
Osceola	Boston	30⅛	30⅛	30⅛	June '20, Q	.50
Phelps Dodge	Open Mar.	†175	†160	....	Jan. '22, Q	1.00
Quincy	Boston	43⅛	42⅛	42⅛	Mar. '20, Q	1.00
Ray Consolidated	New York	15	14⅛	14⅛	Dec. '20, Q	.25
Ray Hercules	N. Y. Curb	*12	*6	*6		
St. Mary's Min. Ld.	Boston	43⅛	43	43	Dec. '21, K	1.00
Seneca Copper	Boston	....	....	24⅛		
Shannon	Boston	1⅛	1	1	Nov. '17, Q	.25
Shattuck Arizona	New York	8⅛	8⅛	8⅛	Jan. '20, Q	.25
South Lake	Boston	†1	†*55	*60		
Superior & Boston	Boston	1⅛	1⅛	1⅛		
Tenn. C. & C. cfs.	New York	10⅛	9⅛	8⅛	May '18, I	1.00
Tuolumne	Boston	*84	*70	*74	May '13	.10
United Verde Ex.	Boston Curb	29⅛	28⅛	28⅛	Nov. 21, Q	.25
Utah Consol.	Boston	2	1⅛	1⅛	Sept. '18,	.25
Utah Copper	New York	64	61⅛	61⅛	Dec, '21 Q	.50
Utah Metal & T.	Boston	1⅛	1 1/16	1 1/16	Dec. '17,	.30
Victoria	Boston	2	1⅛	1⅛		
Winona	Boston	*40	*30	*30		
Wolverine	Boston	110⅛	10⅛	10⅛		
NICKEL-COPPER						
Internat. Nickel	New York	12⅛	11⅛	11⅛	Mar. '19,	.50
Internat. Nickel, pf.	New York	65⅛	60	62⅛	Nov. '21, Q	1.50
LEAD						
National Lead	New York	86	85	85	Dec. '21, Q	1.50
National Lead, pfd.	New York	108	108	108	Dec. '21 Q	1.75
St. Joseph Lead	New York	12⅛	12⅛	12⅛	Dec. '21, Q	.25
QUICKSILVER						
New Idria	Boston	†1⅛	†1	1⅛		
ZINC						
Am. Z. L. & S.	New York	13⅛	12⅛	13	May '20,	1.00
Am. Z. L. & S. pfd.	New York	39⅛	38⅛	39⅛	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	5⅛	5⅛	June '18,	.50
Butte & Superior	New York	22	20⅛	21⅛	Sept. '20,	1.25
Callahan Zn-Ld.	New York	6⅛	5⅛	5⅛	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	124⅛	124⅛	124⅛	Nov. '21 Q	2.00
Yellow Pine	Los Angeles	*50	*50	*50	Sept. '20, Q	.03

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	⅛	⅛	⅛		
Carson Hill	New York	12⅛	11	11⅛		
Cresson Consol. G.	N. Y. Curb	2⅛	2 1/16	2⅛	June '20, Q	$0.10
Dome Extension	Toronto	*73	*69	*73		
Dome Mines	New York	20⅛	18⅛	20⅛	Oct. '21, Q	.25
Florence Goldfield	N.Y. Curb	*28	*25	*25		
Golden Cycle	Colo. Springs	*70	*69	*69⅛	June '21, Q	.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	.05
Hollinger Consol.	Toronto	7.83	7.75	7.81	Dec. '21, 4 wks.	.05
Homestake Mining	New York	55	55	55	Dec. '21, M	.25
Kirkland Lake	Toronto	*33	*27	*32		
Lake Shore	Toronto	1.37	1.30	1.32	Nov. '21, K	.02
McIntyre-Porcupine	Toronto	2.31	2.15	2.29	Jan. '22, K	.05
Porcupine Crown	Toronto	*19	*11	*13⅛	July '17,	.03
Porcupine V. N. T.	Toronto	*24	*17⅛	*20		
Portland	Colo. Springs	*39⅛	*39⅛	*39⅛	Oct. '20, Q	.01
Schumacher	Toronto	*34	*31	*33		
Silver Pick	N. Y. Curb	....	....	*50		
Teck Hughes	Toronto	*22	*16	*21		
Tom Reed	Los Angeles	*40	*38	*40	Dec. '19,	.02
United Eastern	N. Y. Curb	2⅛	2 1/16	2 1/16	Oct. '21, Q	.15
Vindicator Consol.	Colo. Springs	*21	*21	*21	Jan. '20, Q	.01
White Caps Mining	N. Y. Curb	*5	*5	*5		
Yukon Gold	N. Y. Curb	1⅛	1 1/16	1 1/16	June '18,	.02½
SILVER						
Batopilas Mining	New York	....	....	⅛	Dec. '07, I	.12½
Beaver Consol.	Toronto	*20	*18	*19	May '20, K	.03
Coniagas	Toronto	1.50	1.30	1.50	May '21, Q	.12½
Crown Reserve	Toronto	*14⅛	*9⅛	*13⅛	Jan. '17,	.05
Kerr Lake	Toronto	3⅛	3⅛	3⅛	Oct. '21, Q	.12½
La Rose	Toronto	*33⅛	*33	*33	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*15	*14	*15	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.15	1.00	1.00	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	6⅛	6⅛	6⅛	Oct. '21, Q	.15
Ontario Silver	New York	4⅛	4⅛	4⅛	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	.10
Temiskaming	Toronto	*32⅛	*25	*30	Jan. '20, K	.04
Trethewey	Toronto	*7	*6	*6⅛	Jan. '19,	.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*94	*84	*86		
Cash Boy	N. Y. Curb	....	....	*5		
Dolores Esperanza	N. Y. Curb	1⅛	*90	*90		
El Salvador	N. Y. Curb	*6	*4	*4		
Jim Butler	N. Y. Curb	....	....	*6	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	.05
MacNamara M.& M.	N. Y. Curb	*7	*6	*7	May '10,	.02½
Tonopah-Belmont	N. Y. Curb	1⅛	1 1/16	1 1/16	Jan. '22, Q	.05
Tonopah-Divide	N. Y. Curb	*67	*63	*64		
Tonopah-Extension	N. Y. Curb	1⅛	1⅛	1⅛	Jan. '22, Q	.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Oct. '21, SA	.05
West End Consol.	N. Y. Curb	*80	*74	*80	Dec. '19, SA	.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*7	*5	*7	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	†1.00	†*90	*92	Dec. '20,	.15
Chief Consol.	Boston Curb	3	2⅛	3	Aug. '21, Q	.05
Consol. M. & S.	Montreal	....	....	18⅛	Oct. '20, Q	.62½
Daly Mining	Salt Lake	†3.00	†1.00	....	July '20, Q	.10
Daly-West	Boston	†3	†1⅛	2	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	†3	†2⅛	2⅛	Apr. '21, K	.05
Electric Point	Spokane	*4	*4	*4	May '20, SA	.03
Federal M. & S.	New York	9	9	9	Jan. '09,	1.50
Federal M. & S., pfd	New York	39	38	38⅛	Dec. '21, Q	1.00
Florence Silver	Spokane	*19	*17	*18	Apr. '19,	.01½
Grand Central	Salt Lake	†*45	†*36	*41	Jan. '21, K	.01
Hecla Mining	N. Y. Curb	4⅛	4⅛	4⅛	Dec. '21, Q	.17
Iron Blossom Con.	N. Y. Curb	*32	*20	*20	Dec. '21, Q	.02½
Judge M. & S.	Salt Lake	†3.00	†2.00	2.50	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*5	*5	*5	June '21, I	.02
Prince Consol.	Salt Lake	*11	*11	*11	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*4	*3½	*4	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*7	*7	*7		
South Hecla	Salt Lake	....	†*12½	....	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	....	....	*10	Oct. '17,	.05
Stewart Mines	N. Y. Curb	*2	*2	*2	Dec. '15	.05
Tamarack-Custer	Spokane	2.25	2.20	2.20	Jan. '21 K	.04
Tintic Standard	Salt Lake	2.00	1.85	2.00	Dec. '21, Q	.05
Utah Apex	Boston	3⅛	2⅛	2⅛	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*2	*2	*2	Nov. '17,	.01
VANADIUM						
Vanadium Corp.	New York	32⅛	30⅛	31⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	48⅛	48⅛	48⅛	Oct. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	....	....	77	Oct. '21, Q	1.75
SULPHUR						
Freeport, Texas	New York	14⅛	13	13	Nov. '19, Q	1.00
Texas Gulf	New York	41⅛	38⅛	40⅛	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	45⅛	43⅛	44	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf	New York	87	86⅛	86⅛	Dec. '21, Q	1.75
Am. Sm. pf. A	New York	†100	†100	87⅛	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	36	35⅛	35⅛	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	New York	84⅛	82	82⅛	Oct. '21, Q	.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.